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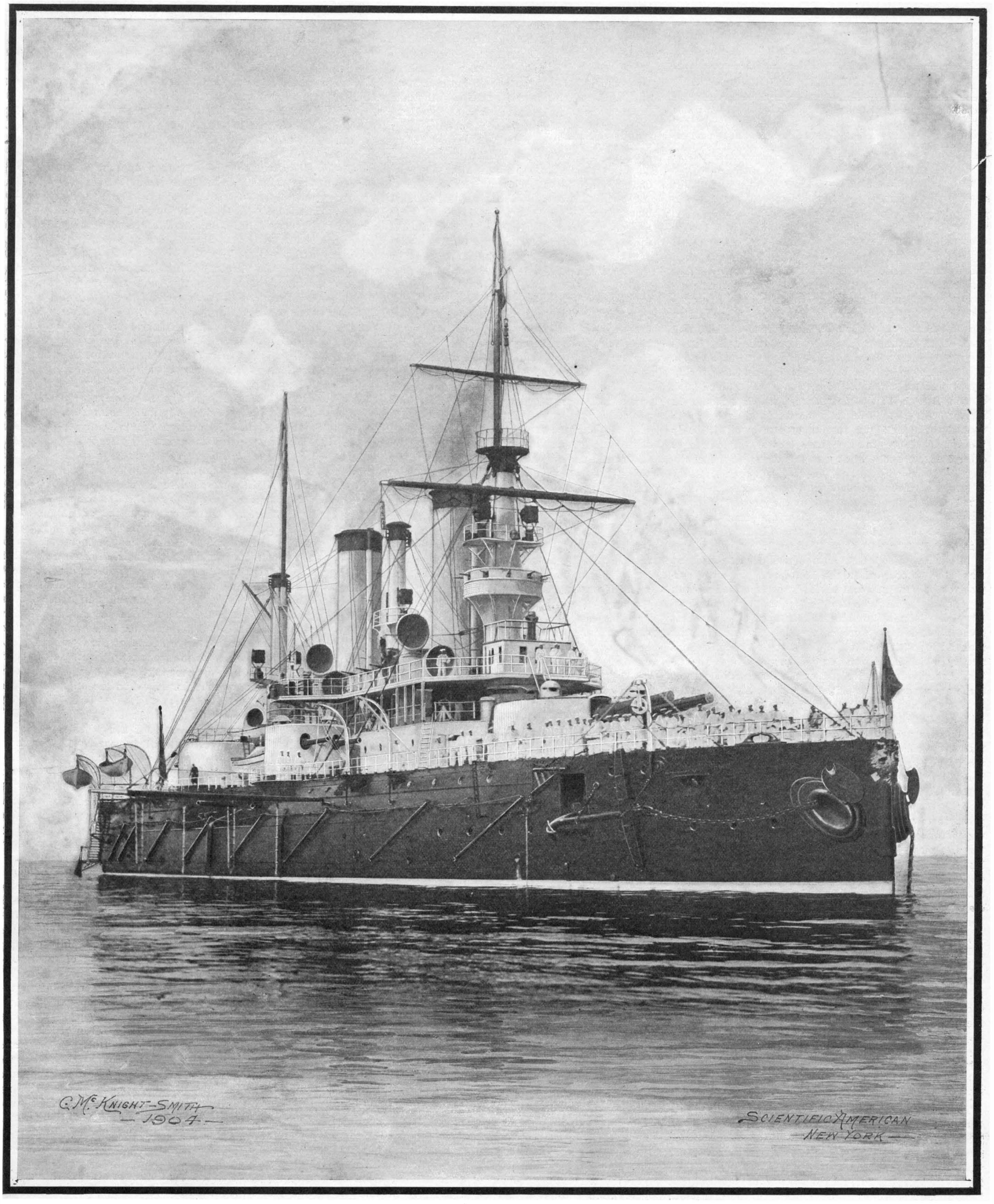

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Displacement, 11,000 tons. **Speed,** 17 knots. **Armament:** Four 12-in., twelve 6-in., 37 smaller guns. **Armor:** Partial belt, 15-in.; main turrets, 10-in.; smaller turrets, 6-in.; deck, 3¼-in. **Torpedo Tubes, 6.**

BATTLESHIP "PETROPAVLOVSK," BLOWN UP AT PORT ARTHUR, WITH THE LOSS OF ADMIRAL MAKAROFF AND 750 OFFICERS AND MEN.—[See page 327.]

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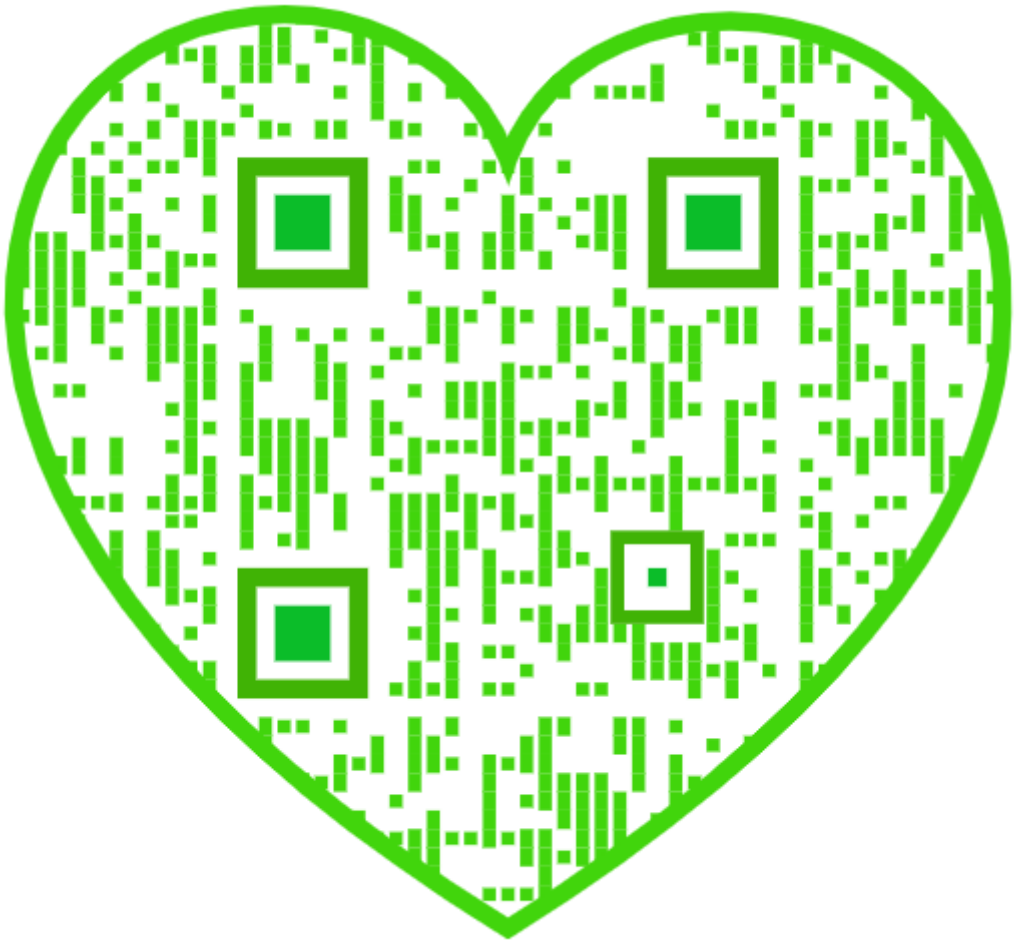

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NEW YORK, SATURDAY, APRIL 23, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE BATTLESHIP "MISSOURI" DISASTER.

The awful calamity that befell the battleship "Missouri" on Wednesday, April 13, when she was engaged in target practice off the port of Pensacola, is the latest of a series of similar accidents which have occurred within the past few years on our own and foreign warships. Some eighteen months ago, while the Russian battleship "Sissoi Veliky" was firing her forward pair of 12-inch guns, there was a terrific explosion, which killed every man in the turret, and completely wrecked the interior of the same. The massive top of the turret was blown bodily into the air, and half of it, falling backward upon the deck, killed twenty-eight men that were standing there in a group. About six months later there was an explosion during target practice in one of the turrets of the 12-inch guns of the British battleship "Mars," which resulted in great loss of life. Then followed the fatal explosion in one of the 8-inch gun turrets of our own battleship "Massachusetts." In each case it was impossible to determine definitely what was the cause of the explosion, the various boards of inquiry being able merely to suggest various conditions which might have rendered the explosion possible. In the present case, because of the fact that every officer and man that was in the turret of the "Missouri" was killed, it is likely that the disaster will have to be written down as one of the unexplained mysteries of which there are so many to be recorded in the history of the use of explosives both on sea and land. The least that we can say for the unfortunate dead is that at the present writing there is not the faintest shred of evidence that these noble fellows were doing aught but discharging their duties with that intelligent care and conscientious fidelity which have won for our navy its high reputation throughout the civilized world. Such accidents as these are a part of the perpetual risks which are taken by those who serve their country on the high seas—risks that are by no means confined to the hour of battle, but are present and are always seriously contemplated by officers and men when ammunition rooms are opened, guns are cast loose, and the terrific weapons of modern warfare are put to the test.

Most earnestly do we deplore the unseemly and officious haste with which such a large section of the press seem ready to rush into an ill-timed and most ungenerous suggestion of carelessness and incompetence, almost before the victims have breathed their last breath in obedience to the call of duty. Whether on the Russian "Sissoi Veliky," the British "Mars," or the American "Missouri," the victims of these shocking disasters are as fully entitled to the honors of naval heroism as if they had died in the fiercest climax of a great sea fight.

The board of inquiry, when it comes to investigate, will carefully sift out what scanty evidence is forthcoming, and if there be any blame, we may be assured it will be rightly placed. But just now it looks as though the only criticism that could be made is that the accident may have happened through the rapidity of the firing. If this is the case, it will simply mean that our gallant sailors have died because they were striving for that very proficiency in the handling of their guns, which it has been the effort of our own and foreign navies to promote to the highest degree.

The accident happened to a modern 12-inch 40-caliber gun of the latest pattern built for our navy These guns are probably the most effective 12-inch guns in existence to-day, having a greater energy per weight of gun than any 12-inch pieces at present in use in any navy. It should be distinctly understood that the accident is in no way attributable to the gun itself. Briefly stated, what happened was as follows:

The left-hand gun, which had already been fired several times during the target practice, was being loaded, and the projectile had been rammed home, together with two of the four 90-pound bags of powder which go to make up a 360-pound charge. The projectile, therefore, was in place, two bags or 180 pounds of powder were rammed up snugly against the base of the shell, and two other bags were in line with the breech of the gun and about to be rammed home, when the first half of the charge that was in place suddenly ignited (nobody knows nor probably will ever know why or how) and the gases, rushing out of the breech, ignited the 180 pounds of powder still remaining in the charging tray. This, of course, produced an enormous mass of flame and heat, and probably portions of the burning powder fell through the well, which opens through the floor of the turret, down to the handling room below. On the floor of the handling room were four charges, or about one and a quarter tons, of powder, which was immediately ignited, and added its awful volume of flame to that of the burning mass above. There is a mournful consolation in the certainty that in the suffocating fumes and fearful heat of that conflagration the death of the twenty-nine officers and men must have been practically instantaneous.

Among the many explanations of the disaster, it has been suggested that there may have been what is known as a "back blast." That is, that when the breech was opened, a certain amount of unburned gases, remaining in the gun after the previous discharge, were blown back through the breech, and meeting with the oxygen of the air, ignited. The "back blast" is not an uncommon occurrence during the firing of big guns, especially if the wind is blowing toward the muzzle of the gun; but the flame produced is instantaneous and not very fierce, the officers being able to stand within a foot or two of the flash without suffering any harm. It is difficult, however, to understand how this could have caused the ignition of the charge; for when the breech is opened the ammunition carriage is, of necessity, some distance below the breech of the gun, being at the time on its way up from the handling room below, so that if there was any back blast, it must have happened several seconds before the powder was hoisted to the breech of the gun, and in that interval of time the gases remaining in the gun would probably have cooled down below the ignition point, and the danger would be passed. Furthermore, the shell had been rammed home into place at the forward end of the powder chamber, and its copper rifling band was practically sealing up the bore. That there was any burning fragment of the "canvas" bags, in which the powder of the previous round was held, remaining in the gun, is extremely unlikely, for the reason that the so-called "canvas" is made of pure wool, to insure its immediate combustion when the charge is fired, and the fierce white heat of the gases in the powder chamber at the instant of explosion is such that every fragment of the bag is instantly consumed. Furthermore, the breech box, powder chamber, and bore of the gun are drenched with a powerful spray of water between each round. From the above considerations it will be seen how difficult it is to connect the explosion of the smokeless powder with the ignition of left-over gases or burning fragments from the previous round. As we have said, the disaster is at present a profound mystery. It is very doubtful if the forthcoming investigation can do much to solve it.

THE ADVANTAGES AND DRAWBACKS OF TURBINES FOR OCEAN STEAMERS.

Further particulars of great interest that have come to hand regarding the report of the turbine commission will, in some respects, cause considerable surprise. In the first place, it was found that, contrary to the generally accepted belief that there would be a considerable economy of weight in the turbine as compared with the reciprocating engines, the use of turbine machinery to develop the 70,000 horse-power required for the new Cunarders will mean a saving of only 300 tons over the weight that would be required if reciprocating engines were used. This statement is rendered the more significant when we learn that the commission advised the steamship company not to rely upon this saving by adding 300 tons to the cargo or other accommodations, but rather to hold it in reserve to be incorporated in the motive power, if need be, as the designs of the turbine machinery are worked out.

The commission admit that the most important disadvantage of the turbine is the lack of economy at low speeds; but they consider that, as the new ships will always run at a uniform speed of 24½ knots, this consideration does not enter into the problem. They state that because of the high sustained speed, the turbines may be depended upon to realize their best economy, and the coal and steam consumption will be superior to that of reciprocating engines. At the same time, it is surprising to learn that, although the tests made on land between reciprocating and turbine engines when both were engaged in driving electrical generators showed a marked superiority in economy for the turbine, especially where superheated steam was used, the tests made in the English Channel between a turbine-propelled vessel and one driven by reciprocating engines showed a superior economy of only two per cent in favor of the turbine. Marked economy, however, is predicted for the large turbines because of the great reduction of the staff in the engine room, and of the small amount of lubricating oil used, and the absence of this oil in the exhaust steam.

The arrangement of the power on four shafts will provide two steam units, each with one high and one low pressure turbine; and should there be any breakdown of one shaft, turbine, or propeller, it would be possible to continue under the three remaining shafts. But for the reason that the turbine can carry a much greater overload than the reciprocating engine, it will be possible to reduce this twenty-five per cent of lost power so very materially that the speed would probably not fall more than a mile or a mile and a half per hour below the normal speed; that is to say, one of the new turbine boats would be capable, if she fractured a shaft, of proceeding on her voyage at a speed of from 23 to 23½ knots an hour. Here alone is a great gain in efficiency which, in itself, we think is sufficient to guarantee the very radical step which is about to be taken.

EXPERIMENTS MADE AT THE LABORATORY IN THE CATACOMBS; EFFECT OF DARKNESS UPON ANIMALS, ETC.

M. Armand Viré gives an account of some experiments which have been carried on at the biological laboratory of the Catacombs. The laboratory was installed in 1896 for the purpose of observing the influence of light and darkness upon different animals. It has two distinct parts, one of which is underground and is located in that part of the Catacombs lying under the Jardin des Plantes, while the second part consists of an aquarium building in the Zoological Gardens. In the first portion the experiments are carried out upon animals which are constantly kept in the dark. On the contrary, it is the subterranean animals which are observed in the second part, and they are exposed to daylight in order to study the modifications which may be thus brought about.

Regarding the normal animals which are kept in the dark, these are especially the Crustaceæ, Batrachians, and different varieties of fish. The crustaceans (*Gammarus fluviatilis*) showed the following phenomena: The gray pigment disappears by patches which increase in size until the entire disappearance of the color. The eye remains normal at first, but after a year it becomes slightly modified in the forepart, although upon dissection no change is remarked in the retina or the optic nerves. On the contrary, the organs of smell, touch, and taste show a marked hypertrophy at the end of a few months. Their length increases gradually until the organs have their dimensions tripled. The observations seem to show that the organs which are now useless, such as the eye, tend to subsist for a considerable time, and this explains in a certain degree the presence of these residual organs in a number of animals, and which could not be accounted for except by this conservative action of the organism. The parts which now become more useful, such as the hearing, touch, and smell, owing to the disuse of the eye, take at once a development which accords with their increased functions.

In the case of the fish a singular phenomenon was observed. After remaining for five years in the dark, the eye of an eel increased in size until it became double its usual volume. This fact would appear to be in contradiction to the preceding, if it is not remarked that the optical nervous system is somewhat reduced, showing thus that the hypertrophy of the external organ will no doubt give place later on to an atrophy. This fact has been observed as far back as 1831 by Eudes Deslongchamps, upon an eel which was taken from the bottom of a well. Another fact remarked in connection with the fish is a reduction of the length in the dark. In the case of twelve gold cyprins (*Carassius auratus*), six were placed in the Catacombs and six in the light. The food was the same for the two portions. After two years the specimens kept in the dark changed their color to a pinkish white. Their length became only one-half that of the second lot, which retained their fine red tint.

The subterranean animals which were kept in the light in order to observe the modifications which might occur were mainly crustaceans (*Niphargus Plateaui*, obtained from the Catacombs and elsewhere; *Vireia burgunda* and *V. berica*, from the Italian caves), and batrachians (*Proteus anguinus*, from Austrian caves). The crustaceans lack the eye and optical nervous system, that is, all the organs which are capable of receiving luminous impressions. The latter specimens have the eye atrophied and covered by the general tegument. Nevertheless, all the specimens are sensitive to light and show by very distinct reactions that light is disagreeable to them. This is probably not a direct perception of the light, but a sensation of a chemical order which is transmitted from the pigment cells to the brain by the general nervous system. In fact, after several months experiment, the Proteus commences to assume a color; at first this is light and diffused, then it becomes darker, ending in a violet black

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coloration with occasionally a series of small yellow patches, except under the head and body, which remain white. With the crustaceans the action is much slower and as yet only slight black patches have appeared on the skin. It is expected to make a series of experiments upon mammals in the underground laboratory as soon as a good system of ventilation is installed in order to supply the necessary fresh air.

THE CAVES AND DENE-HOLES AT CHISELHURST.

BY M. H. H. MACARTNEY.

Chiselhurst, the little Kentish town eleven miles out of London, is very proud of itself just now. And with good reason. Its long-despised chalk pits, of which nobody took any account except when from time to time somebody fell down them, now turn out to be ancient British cave-dwellings which can vie in extent with the Breton subterranean dwellings in La Vendée of which Victor Hugo makes mention in his great novel "Quatre-Vingt-Treize." The last summer was the first year that they have been recognized for what they really are, and therefore they have not as yet been fully explored. But enough has already been done to give the visitor a good idea of the haunts of the ancient British troglodyte, and to show that these caves are among the most marvelous triumphs of early engineering.

From the Chiselhurst station to the caves is only a few minutes' walk, but even in that short time I passed over historic ground; for close to the caves is a double rampart some twenty feet deep, the sole remains of the old covered way which led into the British camp, portions of which are still to be seen. Just beyond is a hill crowned with woodland which forms the extreme outskirt of the mighty Anderida Weald. In this hill lies the entrance to the caves. As I stood for a moment peering into the inky darkness, my guide switched on the electric light. Fancy electric light being installed in these old caves! It was hopelessly incongruous. But the effect was splendid. I looked down a long gallery some 150 feet long, 12 feet high, and 15 feet wide, the chalk walls of which took the green and pink tints of the light in a way which would have been impossible in a cavern of rock. The whole scene reminded me of a representation of Aladdin's cave at a Drury Lane pantomime, but there were no stalagmites and stalactites, which are indispensable to the stage cavern. The walls of this first part are roughly hewn with the pickaxe in a very different fashion to the walls of the Temple itself, which we afterward visited. We came almost immediately upon the first of the many dene-holes. These dene-holes are shafts, about 3 feet 6 inches in width, coming straight through the thanet sand into the chalk, and were made by the ancient Britons during the Keltic or Iron Age. The shafts serve a two-fold purpose. The Britons not only shot their grain down them, but in times of danger swarmed down them themselves either by means of steps cut in the sides or by a notched pole. At the bottom of each dene-hole were six or eight compartments, in which the people lived till the danger had passed away. An attack on these refuges must have been futile. For as only one man could possibly descend at a time he must have fallen an easy victim to the Britons awaiting him at the bottom. Or, again, to try and smoke out the refugees must have been equally futile, since the British wasps need only have given a few blows with their picks upon the soft walls to make an entrance into the next set of chambers, with which the ground is literally honeycombed. But to-day these sets of chambers are not the self-contained flats that they used to be, for when the Romans captured Kent they cut passages intersecting these chambers in the hopes of thus destroying the power of the Druids. The dene-holes too are almost all blocked up and built over, but I was shown one up which I looked to see the sunlight 85 feet away in a villa garden. It was like looking up a huge factory chimney.

By this time we had left behind the electric light and depended only upon a single hand-lamp. We had now come to the Druids' treasure-chamber, the size of which can be clearly traced upon the ceiling. But though the chamber has been broken down, the passage leading from it toward the Temple is still perfect. And a tiny, little zig-zag passage it is, only wide enough to admit one man at a time and not high enough to allow a fair-sized man to stand upright. On both turns it is guarded by a chamber large enough to allow the sentinel to swing an axe. The seat, too, on which the sentry sat and waited for "something to turn up" still remains, and I seized the opportunity to sit down and make a few hasty notes. The passage was once still more secure, the entrance being a hole at ground level, so that the sentinel had merely to bring his axe down on the head of the would-be Bill Sykes as he crawled along on his belly.

Just a little way beyond the end of this passage my guide suddenly stopped and turned his lamp upon a cranny in the roof. "Look up there," he said in an awe-inspired tone; "there are the petrified remains of an ichthyosaurus who was caught here when the sea receded from this part of the land." One great dark leg is all you see, the body of the creature being imbedded in the chalk. My guide now showed signs of giving me some statistics "pitched in the key of emotion" based upon the fact that the sea takes 100 years to form an inch of chalk, but providentially we had now come to the well supplying the place. The present depth of the well is 53 feet. I lit a piece of paper and dropped it down. As it fluttered down I could see how carefully the sides had been "flinted-in," if I may coin the expression, while the steadiness of its flame testified to the purity of the air.

We were now in the very Temple itself, built in the Druidical sign of the circle. The walls here are exquisitely made, and still bear the marks of the triangular iron pickaxes with which they were fashioned over 2,000 years ago. The floors, too, are much harder in this part than elsewhere. Apparently a cement was made of burnt flints and chalk and the floors were then flooded. There are six altars still surviving, which seem to be arranged in pairs. The first and the last are single altars, two are double altars, and two have priest-chambers attached to them. These priest-chambers also are beautifully made and are semi-circular in shape. In one the natural understratum of the chalk has been washed by iron pyrites which has given the roof a lovely color rather like that of a copper-beech. It is a significant fact that these altars follow the sun, being almost exactly orientated; which certainly seems to indicate solar worship as the religion of the ancient Britons. The altars themselves bear no traces of any ornamentation. It has been conjectured that they were used for human sacrifice. The caves beyond the Temple, which were our furthest point (though my guide told me that he had explored another five miles), are, curiously enough, built in the rough sign of a cross. Whether this is accidental or not is unknown. The nave, as it were, has innumerable dwelling rooms and passages opening off it. This part in fact is a regular labyrinth and may have been designedly made so. The part of the Minotaur was played by my guide's pet dog, which had missed him and came tearing out of the darkness after us in a very eerie fashion. An interesting point about these dwelling rooms is that they are never placed exactly opposite to one another, so that the inmates of one could not have overlooked their neighbors across the way. Another remarkable thing is the extraordinary acoustics of the place; the whispering gallery of St. Paul's is not in it. And so back again through the Temple, and the treasure-room passage, and the first great gallery, out into the bright sunshine. For me to attempt to criticise the various theories which have been put forward about the place, would be out of place here. I have contented myself with jotting down the history as told me by the guide. One thing may be confidently predicted: we do not as yet know anything like as much about these caves as we shall after further exploration. And experts are now hard at work upon them.

NEW PROCESS OF MANUFACTURING OZONE.

For the past few years the great importance of ozone for hygienic and industrial purposes has been more and more recognized. The general use of this potentiated form of oxygen was, however, restricted on account of the expensive method of its manufacture. The English engineer Elworth is now said to have found a process for manufacturing ozone that is much simpler than those used heretofore and that permits of a larger production.

Ozone is by him produced in an apparatus into which atmospheric air is forced by means of an air pump. An electric alternating current of 3 amperes at 130 volts, transformed to a potential of 1,100 volts, is then introduced. Through electric discharge in the apparatus, ozone is engendered. The air introduced into the apparatus is forced through an ingenious system of pipes; and, having become highly ozonized, escapes with great velocity through a pipe which conducts it *ad libitum* to the places and the objects intended to be treated with ozone.

The firm of Koelle & Held, of Stuttgart, has for some time past made interesting experiments with these apparatus, which are still continued. It has been proven so far that a much larger quantity of ozone is obtained than by previous methods. The apparatus works very quietly and without any interruption.

It is evident that such an increase of production means a cheapening of the price of ozone and, therefore, a more extended use. The apparatus takes up but little room and can be used wherever the necessary alternating electric current of sufficient power is available, either through a small motor or from larger electric establishments.

Ozone, on account of its great oxidizing power, is well adapted for supplying oxygen to closed rooms, such as theaters, hospitals, manufacturing shops, etc., for purifying drinking water, for the purification of sewage, bleaching of leather, treating oils, etc.

If the new apparatus fulfills expectations, it may result in new possibilities for public hygiene, as also for many industries.

SCIENCE NOTES.

Mr. F. V. Coville, in the National Geographic Magazine, gives an interesting account of how the Indians of the desert obtain drinking water from the barrel cactus. It was among the desert hills west of Torres, Mexico. The Indian cut the top from a plant about five feet high, and, with a blunt stake of palo verde, pounded to a pulp the upper six or eight inches of white flesh in the standing trunk. From this, handful by handful, he squeezed the water into the bowl he had made in the top of the trunk, throwing the discarded pulp on the ground. By this process he secured two or three quarts of clear water, slightly salty and slightly bitter to the taste, but of far better quality than some of the water a desert traveler is occasionally compelled to use. The Indian, dipping this water up in his hands, drank it with evident pleasure and said that his people were accustomed not only to secure their drinking water in this way in times of extreme drought, but that they used it also to mix their meal preparatory to cooking it into bread.

Uranium is one of the rare metals for which there is a limited demand. The present world's consumption amounts annually to about 300 tons of uranium ore, yielding from 3 to 13 per cent of the metal. For several years Colorado has supplied the United States output, nearly all of which goes to Europe. France, England, and Germany are the principal markets. Uranium is a hard, very heavy (9.184) moderately malleable metal; it resembles nickel and iron, and has the color of nickel. At ordinary temperatures it is not affected by air or water; at red-heat, however, the surface oxidizes. The chief ore of uranium is the oxide, called pitchblende or uranium. It occurs also as the phosphate and arsenate. The ores are found in Gilpin and other counties of Colorado; in Cornwall, England; and in Saxony, Germany. Buyers of the ore generally pay from $15 to $20 per unit, according to the percentage of uranium contained. Until recently uranium salts were used chiefly as a pigment in painting on porcelain, in photography, and as a coloring ingredient in glass manufacture. It is now being used experimentally in the manufacture of alloys of iron and of aluminium. Uranium increases the hardness and elasticity of steel, also the hardness of aluminium, but this use has not yet become sufficiently important to cause an increased demand for the metal.—Engineering and Mining Journal.

The trustees of the Carnegie Institution, founded at the city of Washington by the munificence of the well-known philanthropist, Andrew Carnegie, at their annual meeting in December, 1903, took the necessary steps to establish what is now to be known as the "Department of International Research in Terrestrial Magnetism." An allotment of $20,000 was made, with the expectation that, if the proposed work should be successfully organized, a similar sum would be granted annually for the period requisite to carry out the plan submitted by the writer and published in Year Book No. 2 of the Carnegie Institution. It is proposed to set aside $10,000 for office expenses (reduction, discussion, etc., of existing observational data) and $10,000 for observational and experimental work; a portion of the latter sum may be reserved annually and allowed to accumulate for some large undertaking. The general aim of the work is "to investigate such problems of world-wide interest as relate to the magnetic and electric condition of the earth and its atmosphere, not specifically the subject of inquiry of any one country, but of international concern and benefit." The prime purpose, therefore, of this department is not to supplant any existing organization, but rather to supplement, in the most effective manner possible, the work now being done, and to enter only upon such investigations as lie beyond the power and scope of the countries and persons actively interested in terrestrial magnetism and atmospheric electricity.

THE CURRENT SUPPLEMENT.

Mr. Emile Guarini opens the current SUPPLEMENT, No. 1477, with an account of the Berlin telephone exchange. The excellent article by M. Danne, preparator to M. and Mme. Curie, on radium, is concluded. His series of articles may well be considered the most exhaustive discussion of radium and radio-activity that has thus far appeared. Another article that should attract some attention is Dr. Erlwein's discussion of the purification of potable water by means of ozone.

Mr. Frank C. Perkins begins an article on the development of the electric mining locomotive. "The Hospitalier Ondograph" is the title of an article which describes a new instrument for graphically recording current and potential variation of alternating currents. Mr. Hiram Percy Maxim furnishes some data, that are certainly startling, on the cost of operating automobiles for commercial purposes. Mr. Israel C. Russell's paper on "Recent Volcanoes of Southwestern Idaho and Southeastern Oregon" is concluded.

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DRIVING A TEST PILE FOR THE HUDSON RIVER TUNNEL.

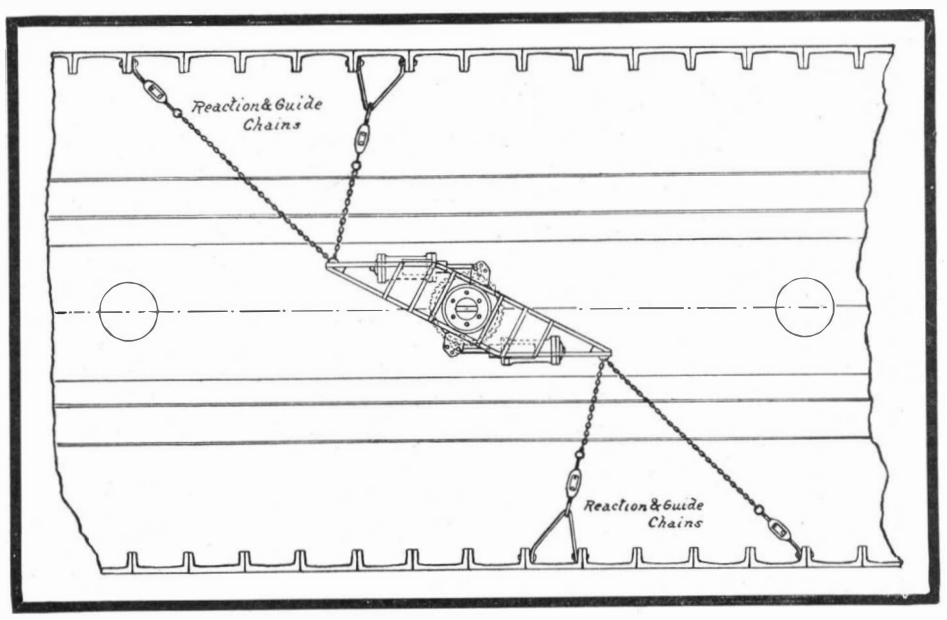
The Pennsylvania Railroad tunnel beneath the Hudson River will be driven through a stratum of silt whose consistency is so uncertain as to necessitate making special provision to support the tunnel and prevent any displacement, either in a vertical or lateral direction. The problem has been carefully studied by the chief engineer of the tunnel, Mr. Charles M. Jacobs, who decided to treat the tunnel as a trestle bridge, driving cast-iron piles, at 15-foot intervals, to the rock underlying the bed of the river, and supporting the track system upon them, the shell of the tunnel serving as a protecting envelope for the trains.

The piles are to be hollow, 27 inches in outside diameter with 1½ inches thickness of shell, and they will be made in 7-foot sections. At the foot the piles will be provided with one turn of a wide screw of 12-inch pitch, whose outside diameter will be about 5 feet. They will be screwed down through a hole in the base of the tunnel shell, a fresh length being bolted on, as each length is screwed down, until the underlying rock is reached.

View of Top of Pile, Showing the Hydraulic Screwing Machine.

With a view to testing the proposed method of driving the piles, and the bearing power of the piles themselves, a test pile was driven in a caisson sunk at the outer end of the Erie Railroad dock "C" in Weehawken, at a point 102 feet south of the center line of the proposed tunnel.

In order to screw the pile down, a hydraulic screwing machine was constructed, as shown on the accompanying line drawing. It consisted of two cylinders attached to a frame and furnished with differential plungers, 11½ and 10 inches diameter by 18 inches stroke. The cylinders were tested to 1,500 pounds water pressure per square inch. The frame was pivoted on a center casting to which a ratchet wheel was keyed; the center casting was bolted to the top of the pile when the machine was in operation. The thrust of the plungers was transmitted by means of connecting rods to pawls, which engaged the teeth of the ratchet wheel, and was guided by the rim of the latter. The screwing machine had ten strokes per revolution of pile.



Plan View of Section of Pennsylvania Railroad Tunnel, Showing Method of Staying and Operating the Pile-Screwing Machine.

It was anticipated the weight of the pile might not be sufficient to force the pile down the full pitch of the screw blade, and a hydraulic jack was built for this purpose. It consisted of a cylinder with a simple plunger, 18 inches diameter by 25 inches stroke. The reaction from this plunger was taken up by weights (pig iron, etc.) on two platforms, which were suspended from cross-beams attached to the plunger of the vertical jack. The whole arrangement is shown on the various cuts.

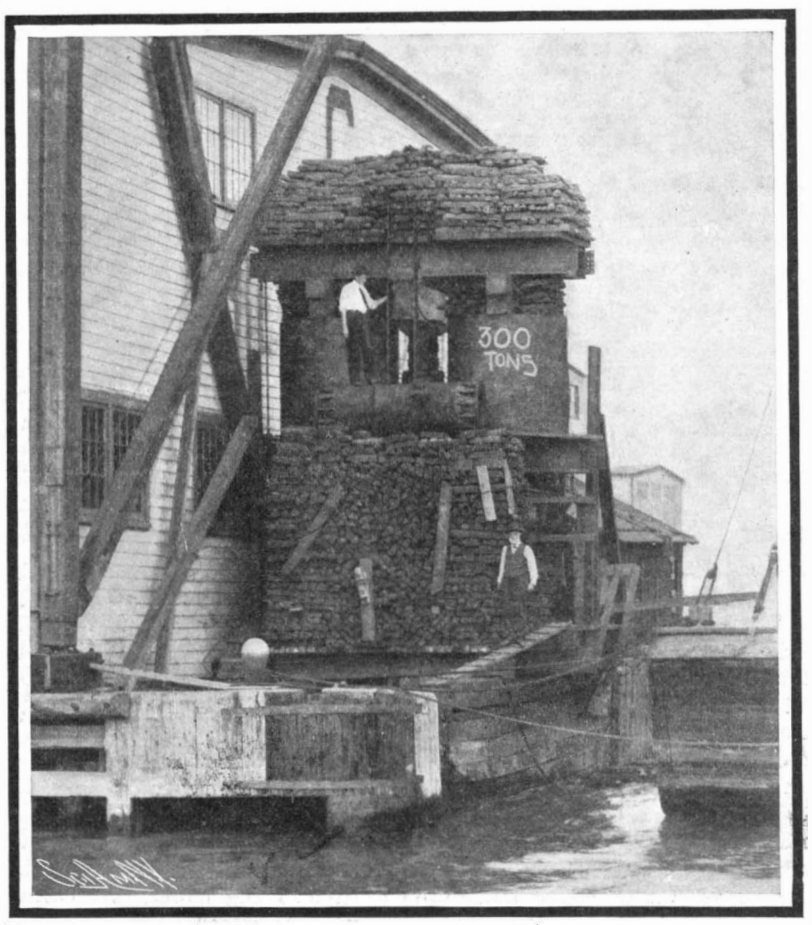
The point of the screw pile was first bolted to eight sections and lowered in the caisson, and afterward seven more sections were added, making fifteen in all before the screw pile came to rest at El. 193.47. The total weight of the pile was now 63,353 pounds.

The screwing machine was then started, and for each turn the pile was driven from a maximum of 1.2 feet to a minimum of 0.21 foot. At the thirty-sixth turn, when the dead load, including the weight of the pile, was 96,140 pounds, the penetration for one turn of the pile was 0.8 foot. The load was then gradually increased until under a load of 383,330 pounds under the operation of the hydraulic jack, the penetration for one revolution was 0.75 foot; and at the fortieth turn it decreased to 0.21 foot. The total penetration for forty revolutions was 35 feet.

The fortieth revolution was not completed, the pile refusing to revolve under a turning moment of 439,800 foot-pounds. The screwing operation was now stopped and arrangements made for the dead-load test.

The actual time occupied (exclusive of all other work, such as placing of fresh sections, etc.) in screwing down 34 feet 10 1-32 inches in thirty-eight and three-quarter turns was 9 hours 5 minutes = 14 minutes per turn, with an average penetration of 10 25-32 inches per turn, and about two-fifths of this time was occupied in making the return stroke of the screwing machine; as previously noted, the machine worked ten strokes to each revolution of the pile.

The test-pile was subjected to dead-load tests, which occupied a period of 5½ months. The load, including the pile itself, was gradually increased from 400,000 pounds to 500,000 pounds by increments of 20,000 pounds. During the first five days of the dead-load test the pile subsided about ¼ inch, and for every 20,000 pounds added thereafter the pile apparently subsided about 0.025 inch, but this was compression in the pile itself, which now measured 148 feet between the screw point and the micrometer attachment. The 500,000 pounds was kept on for about one and a half months, when the load was increased to 600,000 pounds for another month and a half without subsiding. The test was now discontinued and the pile removed. A series of drop tests was previously made on the pile with the point closed under Test No. 2, as follows: A hammer, 3,750 pounds, with a fall of 1 foot, was applied in 132 series of 250 drops each, while the dead load at the same time was increased from 200,000 to 330,000 pounds. Altogether, 33,000 blows were applied at a rate averaging thirty blows per minute.



This Load of 300 Tons Was Allowed to Rest on the Driven Pile for Six Weeks. No Settlement Could be Detected.

DRIVING A TEST PILE FOR THE PENNSYLVANIA RAILROAD HUDSON RIVER TUNNEL.

Artificial Fuels.

Everybody who has spent any time on the continent of Europe has noticed the economy practised by Europeans in the consumption of coal and marveled that the results should be so satisfactory. To be sure, the lofty, tombstone-like porcelain stove of the Germans has a chilly look at first, and the cooler atmosphere of German houses may give one a homesick longing for the furnace-heated rooms of America, but gradually the open-minded stranger comes to look with approval on the European arrangements for keeping warm, and to wonder why his own people have not perceived the beauty, the cleanliness, the economy, and satisfactory results that some patent fuels have to recommend them. That many a Yankee has turned the matter over in his busy brain is attested by a chapter on artificial fuels in Edward W. Parker's report on "The Production of Coal in 1902," which is about to be published by the United States Geological Survey as an extract from the annual volume of Mineral Resources.

Prior to 1902, about 400 patents had been issued in the United States on artificial fuels, but up to the close of 1901 none had proved a commercial success. Mr. Parker gives a list of United States patents granted since January 1, 1902. It remains to be seen whether any of them will be successfully developed. The list includes thirty-seven patents, but contains no mention of fuels made from petroleum or petroleum residue unless used in connection with coal, lignite, or peat. Neither does it include any compounds that have for their object the increase of fuel efficiency unless they are used in the manufacture of the fuel itself. Three patents were used on briquetting machinery.

The steady advance in the price of coal —no less than 40 per cent—which has taken place since 1898 has stimulated experiments looking to the invention of artificial fuels. Results obtained in foreign countries from the use of lignite and peat in briquetted form should encourage producers in the United States to try similar methods of manufacture. Small sizes of anthracite coal formerly wasted are indeed recovered now by washeries from the old culm banks and utilized. A large amount of coal lost in the form of dust or finely pulverized material might also be put into convenient shape for domestic consumption and slack now wasted at many of the bituminous mines in the United States might be used to advantage if compressed into briquettes. There are many indications that the time is not far distant when these neglected fuel resources will all be utilized.

In the report for the year 1902 on the railways in the Straits Settlements it is pointed out that in Perak an addition of 30 miles 3 chains was made to the open line during the year, bringing up the total mileage open for traffic to 274 miles 40 chains. These established through communication between Penang and Taiping, thence the line is open to Bukit Gantang, where there is a break for 7½ miles—which will be completed this year—communication being resumed at Padang Rengas *via* Kuala Kangsar to Ipoh and Bidor. The total mileage of open line from Penang to Bidor is 146 miles.

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NEW ELECTRIC CHRONOMETER FOR TIMING AUTOMOBILES.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The Mors Company, of Paris, has lately brought out an ingenious electric chronometer apparatus which is intended to replace the ordinary method of timing races by the stop-watch. It is especially designed for automobile records, where the need of an accurate method has been felt for some time past. The device consists essentially of two instruments, one of which is placed at the start and the other at the finish, with a single wire running between them. The instrument at the receiving station unrolls a band of paper like that of a telegraph apparatus. When the start takes place a current is sent through the line, thus causing a needle point to be brought momentarily against the paper and to make a dot. When the automobile comes to the finish, a second dot is made, and the time of the run is deduced from the length of the paper which has been unrolled. The apparatus, which was designed by M. Pottier, is illustrated in our engravings. In Fig. 1 is seen the complete outfit. On the left is the apparatus at the starting end, which consists mainly of the device for making the contact. This is accomplished by means of a wire stretched across the course in a suitable manner and attached to a contact device for sending a current through the line. When the front wheels of the car pass over the wire, it is stretched and operates the contact, registering the moment of the start in the receiver. At the other end of the course is a similar wire which registers the exact moment of the finish. The receiving apparatus is seen on the right. The horizontal box of this apparatus, seen in Fig. 1, acts as a table and is similar to that of the apparatus at the start. Both contain a call bell and telephone outfit for signaling between the stations. The chronometer apparatus is contained in a portable case which is placed upon the horizontal box.

The details of the chronometer are shown in Fig. 2, which shows the receiving apparatus in the vertical box. A clockwork mechanism draws a band of paper from the drum on the right by means of a set of rollers. The paper passes through a slot in the cubical brass piece. The band can be punctured from below by a needle which is mounted on a lever. The lever is operated by the solenoid, *A* (Fig. 2), and is controlled by a spring and a pair of thumb screws above the solenoid. A chronometer contained in the box sends current impulses through the solenoid, *A*, at intervals of 1-5th second, and the needle point thus punctures the paper from below. When the band unrolls normally the space between the dots is about a quarter of an inch, which represents the time of 1-5th second. The passage of the car is registered by the upper solenoid, *F*. It contains a core which is held up by a spring. On the lower end of the core is a long needle which passes through a hole in the cubical piece and comes just over the band. When current is sent through the solenoid, *F*, the needle makes a puncture in the paper, which registers the time of the start. The paper continues to unroll while the car is being timed, and the time of the finish is registered by a second puncture. The exact time from start to finish is obtained by counting the number of spaces and fractions which have been unrolled between the two punctures. The position of the dots representing the start and finish can be easily estimated to within 1-20th of a space, and as each space represents 1-5th second, the time can be accurately registered to within 1-100th of a second. Besides all this, the band forms a permanent record of the time. Although the unrolling of the band is not absolutely uniform, the spaces between the dots are practically alike, and the error due to this cause is negligible. M. Pottier has devised an ingenious apparatus for measuring the exact position of the dots showing the start and finish. It consists of a brass plate, *A* (Fig. 3), which slides in a second plate, *B*. The latter holds the paper band in a fixed position by the clamps, *C*. Over the band passes a fine wire, *W W'*, which is held below by the fixed piece, *F*, and above at the second point, *E*. The other end of the wire is held in the sliding piece, *D*, which is adjusted by a thumb screw. To find the exact position of the dot, *n* (representing the start or finish), with reference to the chronometer dots, *m* and *o*, which include the space equal to 1-5th of a second, the plate, *A*, is slid until the upper edge of the band coincides with division No. 20 on the vertical scale. The paper is also shifted so that the point, *o*, comes under the right-hand wire, which is at right angles with the scale divisions. The left-hand wire is then brought over the point, *m*, by shifting the slide by means of its thumb screw. This adjustment is necessary, seeing that the distances, *m o*, are not always exactly equal. The plate, *A*, is now slid so as to bring the wire, *W*, over the point, *n*. If the place where this occurs is at division 14, as shown, the point, *n*, is 14-20ths away from *o*, according to the well-known proportional method. This ingenious and compact device gives a rapid reading of the time between the two punctures, and is one of the essential features in making such a system practical. The Mors apparatus can be also operated by contacts made by hand at the start and finish. In the competitive tests of automatic chronometer apparatus, which were held on the road near Paris, the present device carried off the first honors, as it was considered the best for practical use.

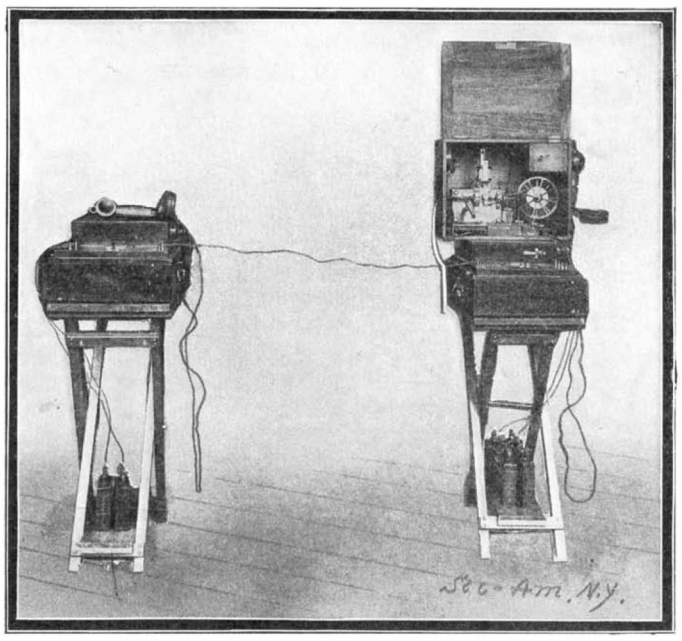


Fig. 1.—The Complete Timing Apparatus.

The horizontal boxes contain telephones and the contact device for making and breaking the electrical circuit when the machine crosses the line.

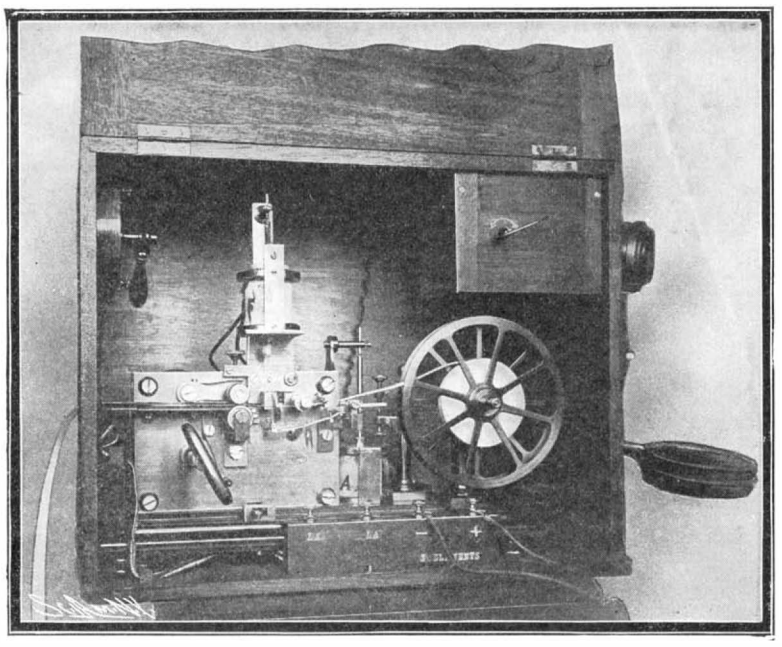


Fig. 2.—The Registering Part of the Mors Timing Apparatus.

NEW ELECTRIC CHRONOMETER FOR TIMING AUTOMOBILES.

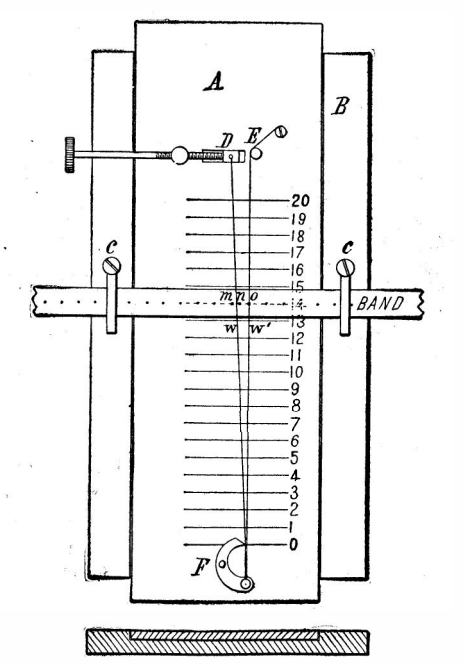


Fig. 3.—Diagram Showing Method of Reading to Hundredths of a Second the Time Registered.

A NEW ENGLISH ALUMINIUM WELDING MACHINE.

BY FRANK C. PERKINS.

A number of machines have been designed in recent years for welding aluminium, which have given only partial success. Among the more important welding apparatus for aluminium should be mentioned the machines of Dick, Schmidt, Heraeus, and Emme. Schmidt designed apparatus for welding aluminium plates, and Jones for welding aluminium tubes, the plate welding being accomplished by an electric arc.

The new welding machine, as well as the new process for welding aluminium designed by the English engineer and electro-chemist, Mr. Sherard Cowper-Coles, is shown in the accompanying illustration, Fig. 1, and described below.

By means of this machine, no solder or flux is required, and the hammering of the joint when in the semi-fluid state is not necessary. It is stated that this process is particularly suitable for wire rods, tubes, and other sections which are drawn or rolled. The aluminium materials to be welded, after being faced off square, are placed in the machine shown in the illustration, Fig. 1, which is fitted with clamping screws capable of moving horizontally on suitable guides.

The machine consists essentially of a double-deck framework with a reservoir, *F*, located under the upper platform. This tank or reservoir supplies water under pressure for quenching the welds instantaneously by turning a handle attached to the screen, *A*. Turning this handle allows the water to run from the tank and be projected on to the welded joint. The pressure in the reservoir is maintained by an air pump, the handle of which is indicated at *E*. The levers, *D*, are arranged for controlling the movement of the clamping screws and the aluminium bar, *B*, which is to be welded. The benzine or gasoline lamp or torch is noted at *C*, and the flame

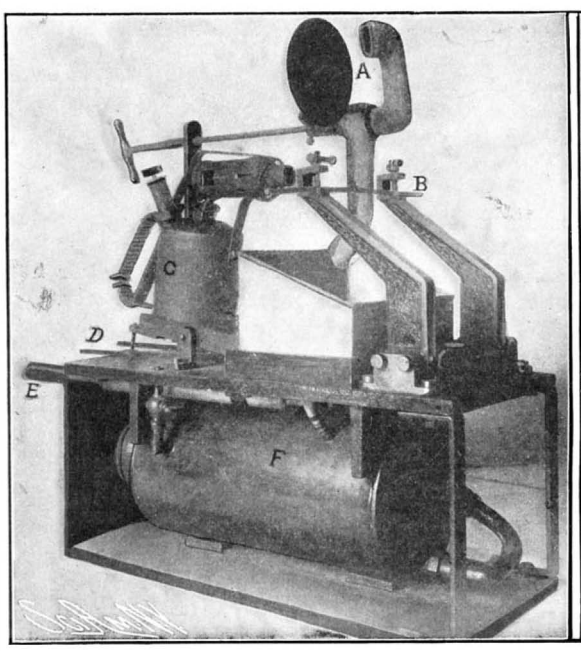
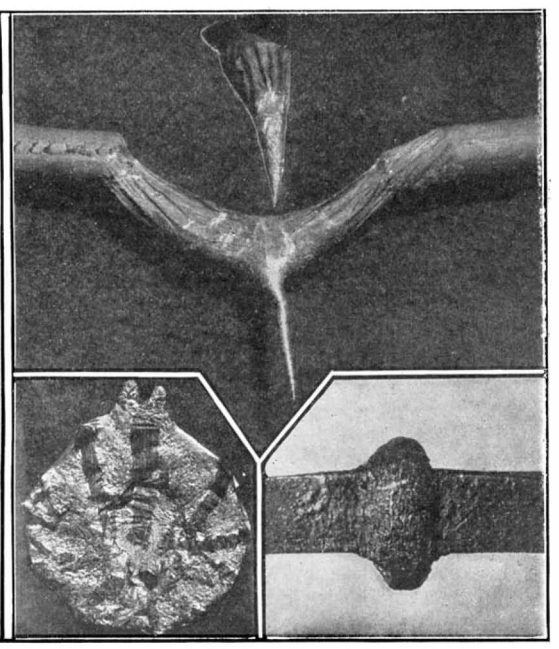


Fig. 1.—A NEW ALUMINIUM WELDING MACHINE.



Figs. 2, 3, 4.—THE WORK OF THE ALUMINIUM WELDING MACHINE.

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from this torch is directed upon the joint of the aluminium bars to be welded at *B*, a box being provided on the top of the platform for catching any molten metal.

The flame from the benzine lamp, *C*, is projected against the aluminium joint to be welded between the clamps at *B*, and when the necessary temperature has been reached by the rods to be welded, a slight pressure is applied to the levers *D*, causing them to unite, and the metal is squeezed out in the shape of a ring, as shown in Fig. 2. It is stated by Mr. Cowper-Coles that this ring of metal is largely composed of aluminium oxide, which acts as an insulating and supporting collar, the molten metal being retained within this collar. The tank, *F*, having previously been supplied with water, and charged with a considerable air pressure by means of the pump located under the upper platform and operated by handle *E*, is ready for supplying through *A* the necessary cooling liquid when the handle controlling the same is moved.

The aluminium bars to be welded, having been placed in the jaws, raised to the proper welding temperature by the flame from the lamp, and pressed together at the proper moment by the levers *D*, a perfect weld is formed at the joint, and as soon as the weld is made, it is rapidly cooled by turning the handle attached to the screen *A*, which allows water under pressure to be projected from the reservoir *F*. The screen, *A*, is placed in front of the heating flame by the same handle which turns on the water, and the water pressure is maintained by the hand pump *F*, which supplies compressed air to the tank. After the rod has been removed from the machine and the collar filed off, it is claimed that the joint is as strong as the rest of the rod.

It is well known that soldered aluminium joints have not been found satisfactory, as they do not stand a great length of time, on account of the galvanic action which takes place between the solder and the aluminium, the former electro-negative to the latter in a voltaic couple. One of the principal difficulties found in the welding of aluminium is that it passes into a mushy or brittle state a few degrees under smelting point, and the solder freezes before flowing properly, it cools so rapidly. The best welding temperature for aluminium, it is claimed, lies just below the point where this pastiness occurs, and this metal has been welded at temperatures varying from 420 deg. C. (788 deg. Fahr.) to 600 deg. C. (1,102 deg. Fahr.), the latter being the temperature proposed by Wiszniewska and Strzelecki for welding aluminium in a non-oxidizing manner, this being accomplished by a heated plate, and in contact with a volatile compound with an affinity for aluminium, say flouride or nitrate of aluminium in a powder or solution. Mr. Cowper-Coles states that an oxy-hydrogen flame or gas with or without air blast can be used instead of the benzine lamp. The accompanying illustration, Fig. 3, shows the case or pipe of aluminium oxide, which supports the molten aluminium within. This view shows the outer shell of aluminium oxide, which has been pricked with a steel point, allowing some of the molten metal within to flow out. One of the beads of molten aluminium, which is incased in aluminium oxide, is shown in Fig. 4, the drop of metal having been allowed to fall on a metal plate. The broken aluminium oxide casing or shell may be noted by the dark portions. In a recent paper before the Faraday Society in London, on "Some Notes on the Welding of Aluminium," by Sherard Cowper-Cowles, he states that Dick in 1900 devised a machine for welding aluminium by the removal of the oxide mechanically, combined with pressure, while Heraeus, of Hanau in Germany, takes advantage of the fact that aluminium becomes plastic at a certain temperature, and can be kneaded into any shape. He further states that electric welding of aluminium has not been successful commercially, either by electric arc heating or by allowing the joint to be welded to form a resistance to the electric current. Aluminium welds have been made by Anderson by means of an electric arc drawn down by a magnet and a special tool and flux, while Schmidt uses a carbon-graphite or platinum stick through which he passes an electric current. By this process, the flow of current is such that the carbon stick acts as an anode with the metal to be welded as a cathode, the carbon stick being used somewhat as in soldering, it being moved over the portions to be welded, removing the oxide formed, the latter being reduced by the heat of the carbon.

On a test of several of a number of welds, made by the Cowper-Coles aluminium welding machine for tensile strength, the fractures occurred at quite a distance from the weld, showing that the metal was not deteriorated. One of the specimens having a diameter of 0.249 inch and an area of 0.0487 square inch was found to have a reduction of area at the fracture of 7.4 per cent, the extension on four inches being 8 per cent, while the break occurred on none of the twelve specimens tested at the welded portion. The specimen above mentioned had an elastic limit of 11,491 pounds per square inch (5.13 tons), while the maximum stress was found to be 20,249 pounds per square inch (9.04 tons). It is stated that in some cases very minute holes were found in the welds, but they were not large enough to affect the strength of the rod which was welded.

Another specimen having a diameter of 0.25 inch, with area of 0.0491 square inch, had a reduction of area at the fracture of 7.7 per cent, the extension on four inches being 9 per cent. The elastic limit was 12,320 pounds per square inch, or 5.5 tons, while the maximum stress was found to be 20,070 pounds per square inch, or 8.96 tons. One of the specimens had an extension of 14 per cent, with a reduction of area at the fracture of 7.7 per cent, the elastic limit in this case being 10,236 pounds per square inch, or 4.57 tons, and the maximum stress 19,152 pounds per square inch, or 8.55 tons per square inch.

Mr. Cowper-Coles states that the Jones process for making aluminium tubes consisted in simultaneously winding a flat strip of the metal in spiral convolutions, welding the abutting edges of the convolutions by the heat generated by the local passage, through the immediate parts to be joined, of a low-tension current of electricity, and pressing the heated edges toward each other with the necessary force.

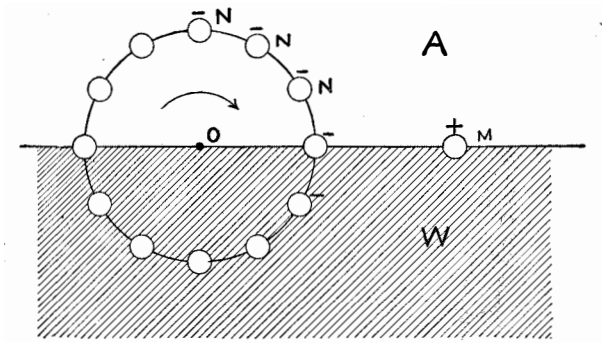
The subject of welding aluminium is a most interesting one, and is of considerable importance, on account of the extensive way in which this new metal is being used in the arts.

AN INTERESTING PARADOX.

BY DANIEL F. COMSTOCK.

Although the chimera of perpetual motion has retreated so far into the distance that scientific men consider themselves absolutely safe in assuming some fallacy in all propositions which involve the creation of energy, yet it sometimes happens that the various components of a system may be so arranged that this fallacy is by no means easy to detect. The common characteristic of such cases is thus rather a psychological than a physical one, for it is in the mind of the observer and not with Dame Nature that complication really exists.

The following is a paradox so apparently simple and yet so delusive that it possesses a peculiar interest:



AN INTERESTING PARADOX.

Referring to the figure, *W* is water and *A* is air. A wheel made of insulating material is constructed to turn about an axis, *O*. The wheel has metal balls, *N*, placed around the periphery, and these are charged negatively, while the fixed metal ball, *M*, is charged positively. Each ball has a thin layer of insulating material surrounding it, in order that the electricity may not leak into the water.

The fixed charge, *M*, will now attract all of the movable charges which are above the surface, but will have practically no effect upon those below the surface. This follows immediately from the fact that the dielectric constant of water is nearly eighty times that of air. In other words, air transmits electrostatic force with eighty times the readiness of water. Hence the astonishing conclusion that the wheel will continuously rotate in the direction indicated by the arrow.

The discovery of the fallacy, which is more or less hidden, is left to the insight of the reader.

The Pollok Prize.

Owing to the unsatisfactory results obtained at the two competitions which have been held for the Pollok prize, it was decided that an investigation should be made for the purpose of securing the opinion and advice of the various maritime associations, boards of trade, and chambers of commerce in the leading cities of the world, as to the best means of accomplishing the end in view.

The International Association of Paris undertook this mission, and, after an extensive investigation, submitted a report some few months ago, in which it was recommended that the Pollok prize be transformed into a permanent endowment fund, the interest to be awarded periodically to the inventor or inventors of the best methods or devices for preventing collisions and loss of life at sea. The founders of the Pollok prize decided to accept the recommendations made, and to place the endowment fund in charge of the International Maritime Association, 3 Rue des Mathurins, Paris. The rules and regulations governing future competitions will be published shortly.

Engineering Notes.

Despite severe competition from American and German locomotive builders, the contract for fifteen powerful compound express locomotives, required by the Chilian railways, has been secured by the North British Locomotive Company, of Glasgow.

The British consul at Trieste, in a recent dispatch, reports that a large establishment for the manufacture of Portland cement will be erected near Albona, in Istria. The output is destined entirely for exportation. It is said that immense quantities of stone adapted for the manufacture of cement exist in the neighborhood, as well as a coal mine. All are situated close to the port of Rabaz.

At a meeting of the Royal Statistical Society held recently, Mr. Edgar J. Harper read a paper on "Statistics of London Traffic." Mr. Harper showed that there were about 600 miles of railway in greater London, of which 222 miles were in the county itself. It would seem that South London was better equipped with railway facilities than North, especially in proportion to population. The number of stations per square mile was almost the same on both sides of the river, but on the north side each station had to serve a population 10 per cent greater on the average than on the south side. The length of railway per square mile in the south was nearly 30 per cent more than in the north, while the population per mile was 45 per cent less. As many long-distance trains arrived from the south as the north, although the local trains were 20 per cent less.

We are accustomed to think and speak of the enormous and steady progress made in modern industrial machinery. While in general this may be true, in the office building it is only true of the details. We are beginning to put into effect improvements suggested years ago, and have made real progress in the direction of carrying out our plans more quickly, and all things considered, more cheaply; but our plans have not changed substantially, and the limiting conditions are the same. We are still aiming to make our buildings attractive, easy to rearrange to suit tenants, well lighted, with convenient internal communication, polite and efficient service, quick elevators, and as accessible as possible to elevated and underground stations. We supply them with every necessity and many luxuries, and do all in our power to get the maximum return for the money invested. The writer considers it certain that for at least a generation there will be an imperative demand for office buildings, and that the present type will be practically unchanged in its broad outlines. The improvement made during the past ten years may be briefly stated. There has been a very slight increase in net elevator speeds obtained mainly by improved signaling devices. Automatic heat regulation is practically unchanged, but it is a little generally used. Gas has practically been entirely replaced by electricity. The finish of the buildings is a little more luxurious and the exterior a little more expensive. The average height of a building is increased. To-day the highest practicable speed for a way elevator is 450 feet per minute, and for an express 600 feet to 700 feet per minute, depending on the distance traveled. We may, therefore, safely say that the future will see but little improvement, except in details.—Architectural Record.

Cornelius Voet, of Haarlem, Netherlands, has invented a novel coal-saving apparatus which seems promising. The company for the management of the State's Railways in the Kingdom of the Netherlands tested the apparatus at the Central Electric Works in Utrecht during 11½ successive hours, during which trial a saving of 18.2 per cent was found. The Steam Navigation Service of the Royal Dutch Navy, Section Amsterdam, applied the apparatus to the boiler of a dispatch boat. The inspector declares that the apparatus upon trial gave excellent saving results, and upon further use proved quite satisfactory. On a German steamer of the firm Fried. Krupp at Essen, on twelve voyages from Rotterdam-Bilbao and Santander and back to Rotterdam, the following results were obtained: Without apparatus, 13.13 tons of coal used per 24 hours; with apparatus, 12.01 tons of coal used per 24 hours. The apparatus supplies the furnaces of boilers with the air necessary for combustion and to apparatus therefor. In the ordinary way such supply of air is obtained either by artificial draft or by a blower or blast device. In the case of artificial draft the air is drawn by the chimney through the grate and the fire-tubes, while in cases where blast is used the air is forced through the grate at a pressure in excess of that of the surrounding air. This excess pressure is produced in all known cases by means of a blower or blast device. Mr. Voet's invention relates to an arrangement whereby such excess pressure is produced by the outer air itself, the air being received and pressed by the pressure of the outside air or current into air-collecting heads communicating through pipes with the space under the grate, into which the air rushes with the excess pressure thus acquired.

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THE RUSSIAN REVERSE AT PORT ARTHUR.

On April 13, Admiral Togo led his fleet for the seventh time to the attack of Port Arthur and the Russian fleet that has taken refuge behind its guns. The result was only less disastrous to Russia than the memorable action off Port Arthur on February 9 with which the war was opened, one of her battleships being sunk, either by a mine or torpedo, another battleship more or less crippled by the same agency, and one of her best torpedo-boat destroyers sunk by the combined attack of several Japanese vessels of the same type. This, however, was not the most serious part of the Russian losses; for when the flagship "Petropavlovsk" went down, she carried with her Admiral Makaroff and most of his staff, with nearly the whole of the crew of 750 men.

At the present writing it is difficult to determine exactly what was the nature of the operations that occurred on this memorable day; but after reading the official accounts given out by the governments at St. Petersburg and Tokio, it would seem that some of the Russian cruisers and torpedo-boat destroyers had been out reconnoitering during the previous night, and were intercepted by vessels of the same class of the Japanese fleet. The armored cruiser "Bayan," moreover, was sighted by the British gunboat "Espiegle" early in the morning of Wednesday, making a running fight with several Japanese cruisers, in which she just succeeded in gaining Port Arthur. Because of the hot fire to which she was subjected, and the fact that a dense cloud of steam was seen rolling from the vessel as she neared the harbor, it was judged that she was probably hard hit.

The operations at Port Arthur were opened early in the morning by an attack of the Japanese torpedo boats, probably directed against Admiral Makaroff's fleet, which, we may presume, was in the outer roadstead behind the protection of the mines and under the shelter of the guns of the forts. This was followed by a sortie of the whole Russian fleet, which in all probability made a reconnaissance in force some distance from Port Arthur. What followed is somewhat confusing. The reports given out at St. Petersburg state that Admiral Makaroff proceeded until he came in touch with the whole force of the Japanese, estimated at forty ships; that he immediately fell back to Port Arthur; that during this movement the Russian torpedo destroyer "Bezstrashni" was cut off, surrounded by several Japanese destroyers, and sunk, with a loss of all but five men out of her complement of 55 men; that when the fleet was entering the harbor, the flagship "Petropavlovsk" struck a submarine mine, and that the explosion was so terrific that she heeled over and sank within two minutes after she was struck, carrying down Admiral Makaroff, most of his staff, and over seven hundred of the crew. On the other hand, the correspondent of the London Times, which paper has chartered a steamship for the especial observation of Port Arthur, states that the torpedo boats attacked Port Arthur early Wednesday morning, and that the whole fleet of forty vessels commenced the bombardment of that place at 9:45 in the morning. From Rome there came a dispatch to the effect that the Japanese sent a few of their ships to Port Arthur, with instructions to retreat and draw out the Russian fleet in pursuit; that the ruse succeeded, and that Admiral Togo then steamed in, took up position off Port Arthur, and commenced a bombardment; that Admiral Makaroff returning found himself in the presence of an overwhelming force, through which he endeavored to force his way into Port Arthur, and that it was in this attempt that the Russian losses occurred.

We are inclined to think that the account coming from Rome is probably correct, especially as the official statement from Tokio said that the "Petropavlovsk" was torpedoed by the Japanese, and that a destroyer was also sunk. The Russians further admit that the battleship "Pobieda" was struck by a mine on the starboard side amidships. It was on the same side that the "Petropavlovsk" was struck, and we think it will probably transpire that both battleships were victims of the torpedo, fired either from the Japanese battleships or from their destroyers.

The "Petropavlovsk" is one of three sister ships (of which the other two are the "Poltava" and the "Sevastopol") built in 1894-95. All three vessels were at Port Arthur at the opening of the war. They are of 11,000 tons and 15½ to 16½ knots speed under natural draft, with a forced-draft speed of 17 knots. They have a partial belt of 15-inch Harvey armor, a flat 3½-inch steel deck, 4 inches of armor on the lower deck over the central redoubt, 10 inches of armor on the main turrets, and 6 inches on the smaller turrets. They carry four 35-caliber 12-inch guns in two turrets, twelve 45-caliber 6-inch guns, eight of them in four turrets, the latter placed one at each corner of the central redoubt, and four between the turrets on the gun deck, two on each broadside. They also carry one 9-pounder, sixteen 3-pounders, twelve 1-pounders, and eight smaller guns. They have six above-water torpedo tubes, two on either broadside, one in the bow and one in the stern. Although they are not up to modern requirements for a first-class battleship, they are serviceable vessels, and the loss of the "Petropavlovsk" is a most serious blow to the Port Arthur fleet. The other battleship which the Russians acknowledge to have been mined or torpedoed is the "Pobieda," one of three practically identical ships of which the other two are the "Peresviet," now at Port Arthur, and the "Osliabia," which was on her way out to the Far East when the war opened and is now slowly returning through the Mediterranean. The "Pobieda," launched in 1900, is a high-freeboard vessel carrying four 45-caliber, 10-inch guns in turrets, eleven 45-caliber 6-inch guns in casemates, twenty 3-inch guns, and twenty-six smaller guns. She also has two submerged and four above-water torpedo tubes. She has a complete belt of armor 9 inches thick amidships, a 2¾-inch deck, 5 inches protection on the lower deck amidships, 10 inches of armor on her main turrets, and 5 inches on the casemates. She is a vessel of 18.5 knots trial speed, and she carries a maximum coal supply of 2,000 tons, besides liquid fuel.

This last disaster will reduce the once formidable Port Arthur fleet to a mere remnant of its former self. In place of seven excellent battleships she now has but three, the "Poltava," "Sevastopol," and "Peresviet," that are effective, if, indeed, the "Poltava" has yet been repaired. In Admiral Makaroff the Russians lose their most popular and probably most accomplished naval officer; a man who achieved notoriety in the Russo-Turkish war, when he opened the eyes of the world to the tremendous destructive powers of torpedo warfare. To him the Russian people owe the fleet of ice-breakers which have done such good work in keeping open the ice-bound Russian harbors. Since his advent to Port Arthur, a more aggressive policy has been followed. This has been highly acceptable to the Russian public; but it is doubtful whether it would not have been wiser to have carefully preserved what was left of the Russian fleet under the shelter of the Port Arthur fortifications, awaiting the arrival of the Baltic fleet during the coming summer. Another sortie, followed by a similar disaster to this last, will place matters in such a fix that it will be questionable if the powerful Baltic fleet on its arrival could turn the tide in favor of the Russian arms.

The Gordon-Bennett Race.

The eliminating trials for the Gordon-Bennett cup race are to be held over the Ardennes circuit route, in order to determine the champions who are to represent France in this event. The machines which are entered for this competition are three Panhard & Levassor, three De Dietrich, two Turcat-Méry, three Gobron-Brillié, three Bayard, three Darracq, three Hotchkiss, three Mors, three Georges-Richard, and three Serpollet. Among the well-known chauffeurs who are to pilot the cars are Henri Farman, Rigally, the Fournier brothers, Salleron, Gabriel, etc. The Darracq and the Georges-Richard cars are said to be the lightest of the French makes. As concerns the foreign cars, the Mercedes occupies the front rank, and these cars are among the most formidable competitors. At least five of these cars, and perhaps six, are to be entered for the cup race, two or three of them in the German team and three in the Austrian. The new Mercedes cars, of the 90-horse-power type, are to be equipped with powerful motors of the latest design, having 7-inch cylinder bore and a 6-inch stroke. These motors are expected to make an extraordinary speed, and even exceed their performance in last year's races. The drivers designated for two of the German cars are Jenatzy and Baron De Caters, both of whom are Belgians. The Austrian cars will be piloted by Braun, Werner, and the well-known American, Warden.

Dr. Baskerville's Two New Elements.

Dr. Baskerville, whose position as professor of chemistry at a prominent Southern university entitles his utterances to every consideration, recently announced that he had discovered what are probably two new elements associated with thorium, both of them radio-active. The two new substances have been christened carolinium and berzelium. Samples of the substances isolated by Prof. Baskerville have been sent to Sir William Crookes, who will doubtless confirm or disaffirm the assertion that they are new elements.

The importance of the discovery, if it should ultimately appear that the two new substances are elements, can hardly be overestimated; for the number of radio-active substances is now increased to about six. Sir William Ramsay is reported as having every confidence in Dr. Baskerville's announcement.

Eighteen automobile attachments were entered in a side-slipping contest which took place on the track at the works of Messrs. Clement Talbot, near Ladbrooke Grove, England. The contest was commenced by an endurance run of 1,000 miles. After the completion of this performance, the track was greased, and the cars driven onto the slippery surface and compelled to make right-angle turns and describe S curves, and also subjected to brake tests. The object of the test was to find some device which would effectually prevent side-slipping, and the preliminary run was for the purpose of determining the serviceability of the device. The amount of power consumed by the device was arrived at by allowing the car to move down hill by gravity with and without the attachment, and the difference of the two stopping points measured carefully. Points were given for ease of attachment and renewal and cost and effectiveness as shown by the tests.

Electrical Notes.

Mr. E. B. Green, superintendent of the Edison Illuminating Electric Company at Altoona, Pa., writes to the Electrical World and Engineer of his successful use of electricity for thawing water pipes. He has thawed 250 feet of 1-inch iron pipe in 20 minutes, using between 18 and 20 kilowatts; for between 30 and 40 feet of ¾-inch pipe, 5 to 8 minutes and 11 to 15 kilowatts are required. The voltage is reduced to not over 50 and the connection made to the pipe to be thawed and to a hydrant or other connection to the main on the other side of the frozen portion. The work is performed for customers in less time and with much more cleanliness than it could be done by the plumber. The cost lies chiefly in the carting of the apparatus and labor.

In a recent issue of the Elettricita, we note a report of an experiment made at Ferrara by Prof. Battelli and Prof. Rigi on the Turchi-Brunè system of simultaneous telegraphy and telephony. The working of the apparatus is stated to have been so safe as to place beyond doubt the practicability of the method. After the Bologna telegraph inspector had allowed those present to test the various devices used in connection with the experiments (when the most recent device where the differential coil is replaced by an ordinary line coil aroused special interest by its simplicity and efficiency), telegraphing and telephoning were carried out simultaneously on a large scale, with a view to contradicting the statement that the scheme in question would allow of protecting the telephone receiver only against disturbing currents of very low frequency. In fact, the telephonic conversations were heard with perfect distinctness and strength while current impulses of very high frequency were generated in the same wire by means of a Wheatstone telegraph apparatus. In order next to test the simple means by which the disturbances due to currents traversing the neighboring parallel circuits may be eliminated, the telegraph wire 121 (Venice-Florence) was used for telephoning, while the parallel wire 86 (Venice-Genoa) was in full operation, when excellent results were obtained. The telegraph line could also be connected to a local apparatus representing a telephone subscriber, thus showing the possibility of conversations over telegraph wires in the interurban service. As regards the transmitting capacity of the Brunè-Turchi apparatus, the limiting distances appear to be the same as in the case of ordinary telephones.

With an ever-increasing use of rubber in manufacturing, it is disappointing to have to record a gradual diminution in the supply. Some figures have been published purporting to show the total production of rubber in different parts of the world, and according to these the production in the two years from 1900 to 1902 decreased by some 3,500 tons—that is to say, whereas the total output in 1900 was 57,500 tons, that in 1902 was only 54,000 tons. This decrease is certainly not a large one, but it is important as showing the tendency of the rubber supply to diminish. It is very instructive to examine the figures given for the different countries. Our two main sources of supply are Brazil, Peru, and Bolivia, and East and West Africa and the Congo country. From the first group the total supply in 1900 was 25,000 tons, and from the second 24,000 tons, but whereas in the former case the production has increased, it has appreciably decreased in the case of the latter. Thus, Brazil, Peru, and Bolivia contributed 30,000 tons to the world's supply in 1902 as against 20,000 tons for East and West Africa and the Congo country. A small supply is now had from the Straits Settlements, but in 1902 the output was only 1,000 tons. In every other case the production shows a decrease. The various states of South America gave 3,500 tons in 1900 and 1,000 tons in 1902, Central America and Mexico gave 2,500 tons and 2,000 tons respectively, Java, Borneo, etc., 1,000 tons in 1900 and nothing in 1902, and similarly the supplies from Madagascar and Mauritius, and India, Burma, and Ceylon have ceased altogether. Thus, of the total supply of 54,000 tons in 1902 as much as 50,000 tons came from Brazil, Peru, and Bolivia, and East and West Africa and the Congo country, which remain the world's chief sources of supply.

The Belgian Commission in Cuba, in a report to the Department of Foreign Affairs in Brussels, says that Cuba is an excellent market for automobiles owing to their constantly increasing use. The most popular type is the voiturette, and the commission recommends a strongly-built car of about 10 horse power, able to stand the poor roads, and moderate in price.

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THE GREATEST OF PIPE ORGANS.

BY HELEN LUKENS JONES.

The world's greatest pipe organ is being built in a western factory for the Convention Hall in Kansas City, Mo. It has been leased by the management of the St. Louis Exposition, and will be temporarily installed in the Festival Hall on the fair grounds, where its titanic voice will bestow a musical benediction on the opening ceremonies of the great international exposition.

Some of the most renowned organists in the country have been engaged to play on the mammoth instrument, and acres and acres of automatic music are being prepared to fill in the interims between the performances of the virtuosos. At the close of the fair the organ will be permanently established in the Convention Hall at Kansas City.

This wonderful American instrument is the largest in the world. It has 10,000 pipes, 140 stops, and weighs 125 tons. It measures 100 by 27½ feet, and is 40 feet high. Eighty thousand feet of lumber are being used in its construction, and it will require ten freight cars to transport the finished instrument to the exposition grounds at St. Louis. It will cost $67,000.

The pipe organ in the town hall at Sydney, N. S. W., has heretofore been the champion music producer of the world. It has 128 speaking stops, 9,000 pipes, and covers 1,600 square feet of floor space. The largest organ in America is in the Chicago Auditorium. It has 109 speaking stops and 7,124 pipes, is 44 feet long, 25 feet wide, and 34 feet high.

During the last five centuries, or practically speaking, ever since broken reeds gave inspiration to the musical inventor, organ building has progressed steadily, until to-day it has culminated in this new pipe organ.

A visit to the immense brick factory where the organ is nearing completion, and a long tramp through the workrooms where great numbers of men are busily employed in fashioning the various parts of the great melody box, is a revelation in musical industry.

The frame of the organ, which is equal in size and appearance to a house of several stories, is made of 3 x 12 Oregon pine, which is superior in strength and stiffness to any other timber. Other parts of the organ, including the wooden pipes, are made of first quality of sugar pine. Poplar is used only for bellows folds and rack boards. The main console is constructed of quarter-sawed white oak finished medium antique, and the outer frame casing of the organ will be of 10,000 feet of the finest quartered oak.

The chests are twelve feet long with large windways and channels. There are five 12 x 6 bellows for the main and pedal organs, each bellows having three square feeders attached. Four bellows in tiers, one above the other, are operated by four crank-shafts made of heavy steel shafting, with extra large steel cranks of ten-inch throw. There are two crankshafts on either side of the bellows. The two upper ones operate the two upper sets of feeders, while the two lower ones operate the two lower sets of feeders. The feeders are tied together with self-oiling V-plates, so that each crank operates on two feeders of each side. Each crankshaft is made of 1 15-16-inch diameter steel shafting, with six pillow blocks on each shaft, which are fastened to heavy angle-iron plates. The crankshafts are so arranged from the countershafts that they turn toward each other. By this arrangement the strain of tying the two sets of feeders together on each bellows will give it a perfect alinement, and there will be no side drawing to interfere with the folds of the feeders.

All regulators throughout the organ have two square feet per speaking stop, so that there will be ample supply of wind under all conditions. The wind power of this organ exceeds that used by any other organ in the world. There are two motors of twelve and one-half horsepower each, and one motor of two horsepower. The batteries have four cells of two volts each. A generator provides a direct current of 10 volts and 40 amperes, which will supply the storage batteries without charging through the lamps. The motor generator is so arranged that the organ can be played incessantly for six months or more without hitch of any kind. If an ample amount of amperes is supplied and the current kept up to 8 volts, but not over 8½ maximum, the organ can be played continuously, a feat which cannot be accomplished by any other organ in the world.

There are 1,300 magnets in the organ, both key and draw-stop action. The organ contains 115 miles of wire in the cables and magnets, from No. 20 to No. 34 B. & S. gage. Five automatic swell engines operate the swell folds.

There are over 7,000 open circuits in the organ. The coupler contacts clean themselves automatically, so the coupler action never gives any trouble. There are more than 300 pounds of brass rod and strip in the organ. There are 1,616 automatic combination knobs, for setting combinations throughout the organ.

The organ is being built under the Fleming electro-pneumatic system. Mr. W. B. Fleming, the designer and architect of this instrument, has incorporated all of the known musical devices in the organ, besides adding numerous absolutely new creations in the way of sound producers, the products of his own genius.

There are 90 pistons in the organ, 45 on the main console and 45 on the automatic. The placing of this unprecedented number of pistons between the keys, for the purpose of operating the combination action on the manuals, is a notable achievement for the musical world. Another achievement almost as remarkable is the placing of 36 couplers on the main console and 23 on the automatic. The divisions of the great organ are as follows:

First Division—13 speaking stops, 793 pipes.

Second Division—13 stops, 1,342 pipes.

Swell First Division—all string tones 11 stops, 1,098 pipes.

These string tone stops, containing unlimited possibilities for wonderful orchestral effects, are placed in a separate apartment.

This is an entirely new departure in organ building.

Swell Second Division—33 stops, 1,769 pipes.

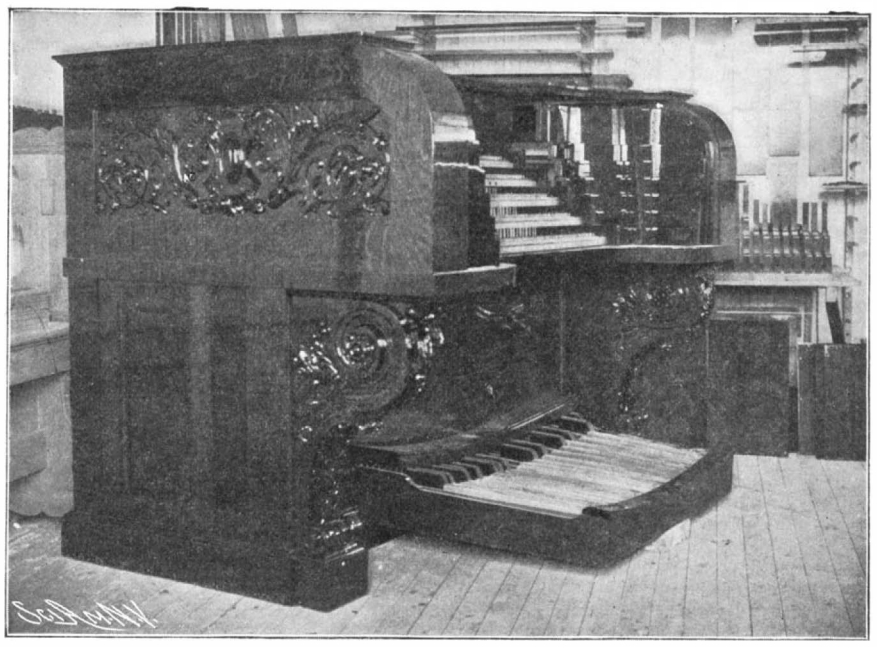
Choir—15 stops, 1,464 pipes.

Solo Organ—16 stops, 1,385 pipes, 2 drums.

Echo Organ—12 stops, 1,170 pipes.

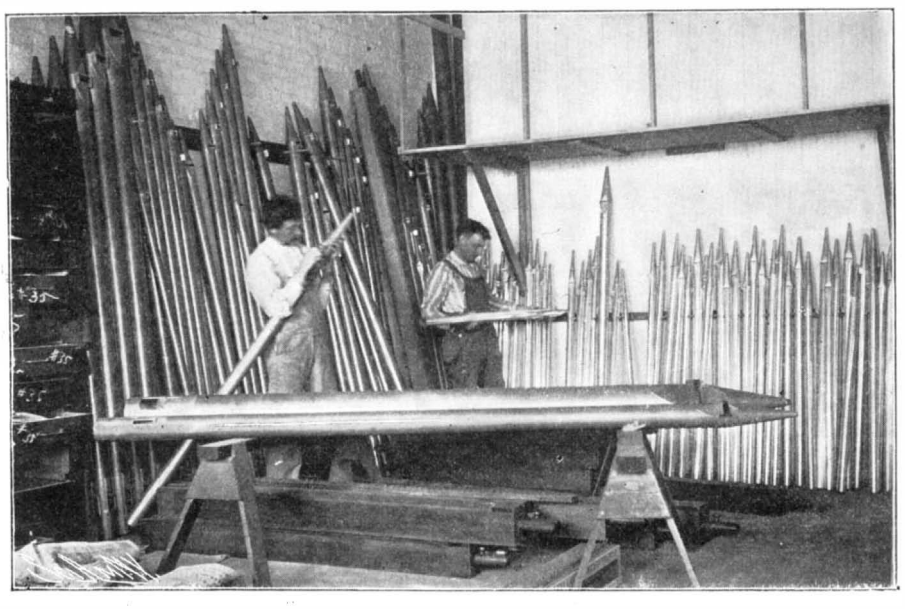
The echo organ is practically an independent section, and will be placed about 300 feet from the main organ. Though it has its own motor and bellows, it will be under the control of the main console.

Pedal Organ—27 speaking stops, 1,012 pipes. The pedal organ will form the

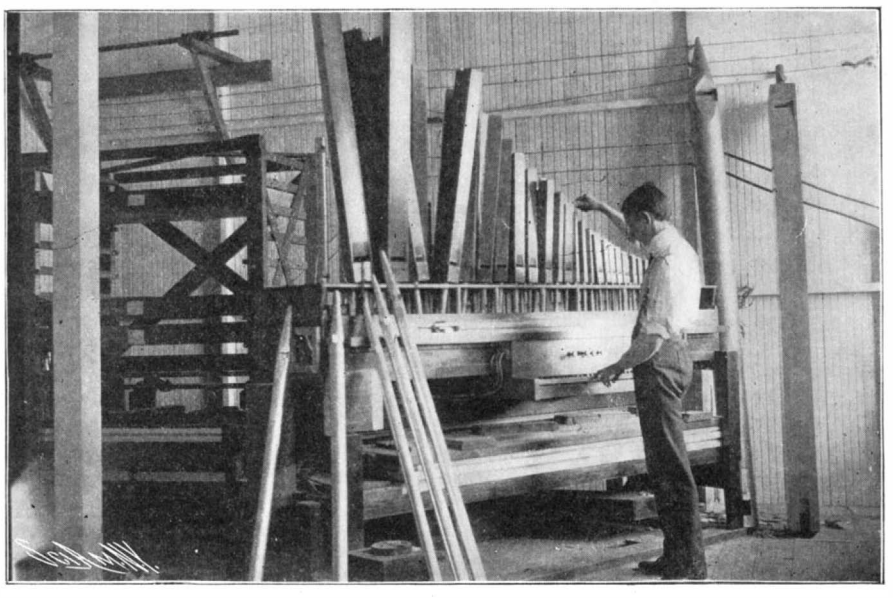


The Huge Console.

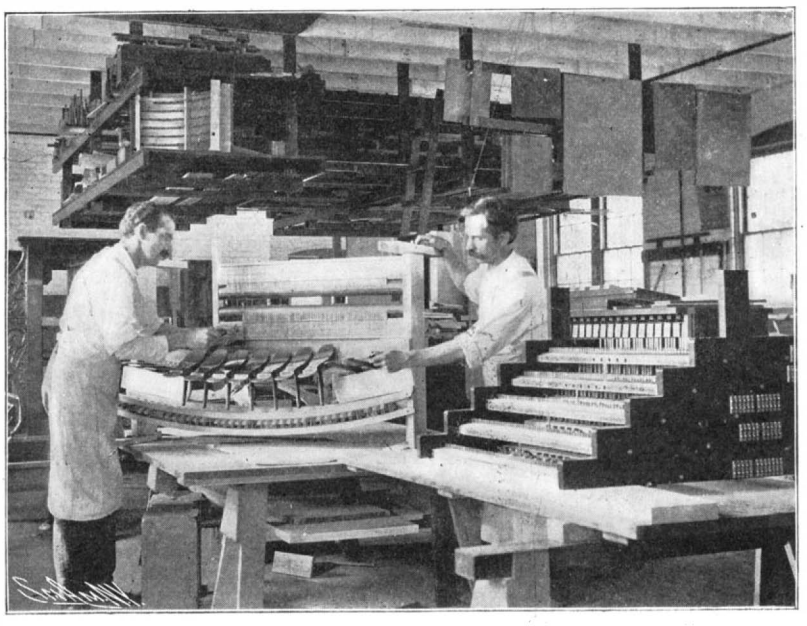
In the Pipe Room.



Inserting the Reeds in the Pipes.



Machine by Which Each of the 10,000 Pipes is Tuned.



Pedals and Keyboard.

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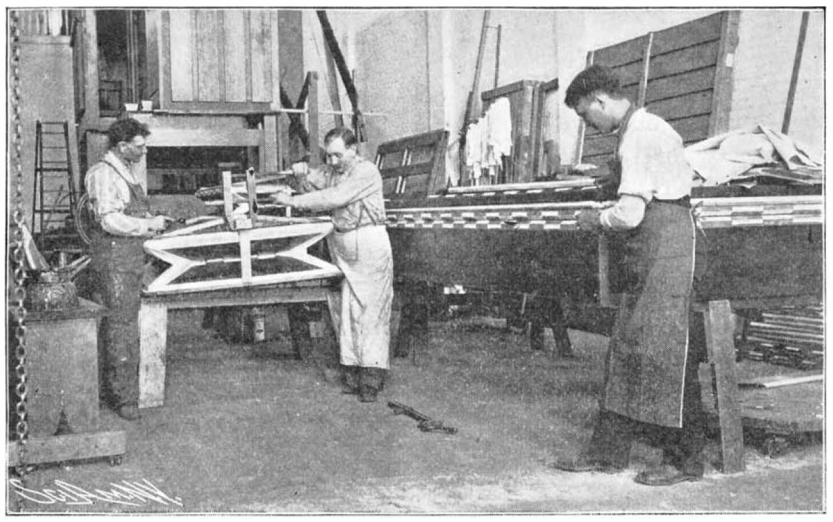
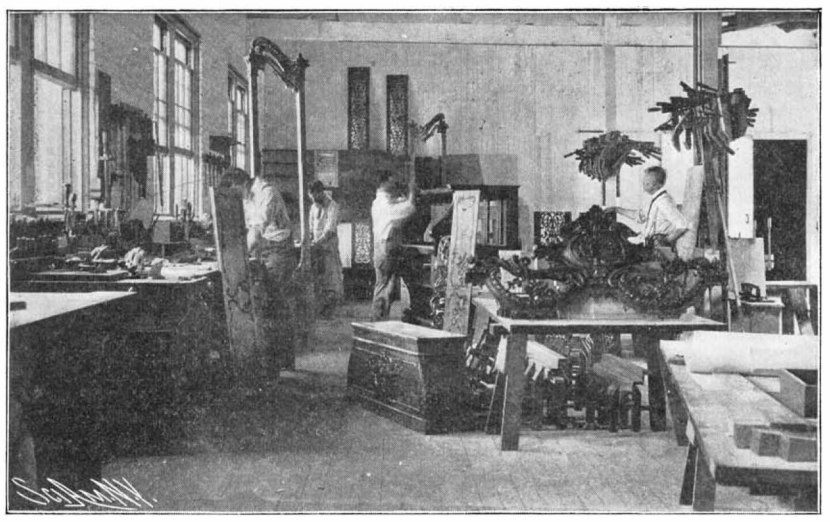
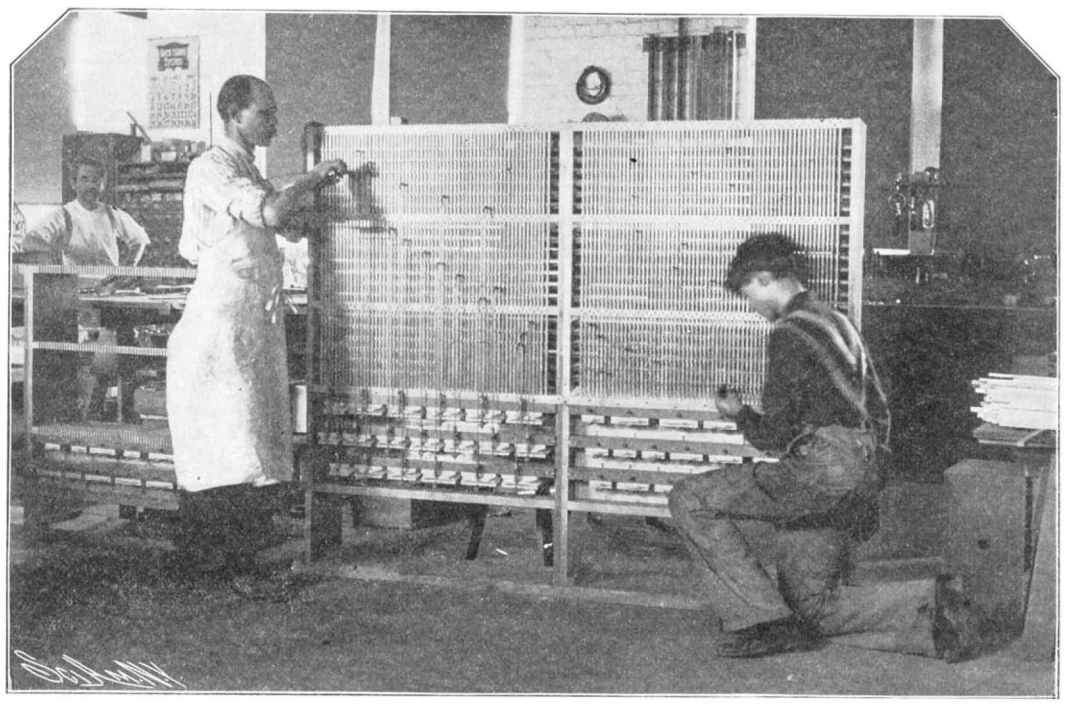


Constructing the Bellows.



Carving Wood for the Case.



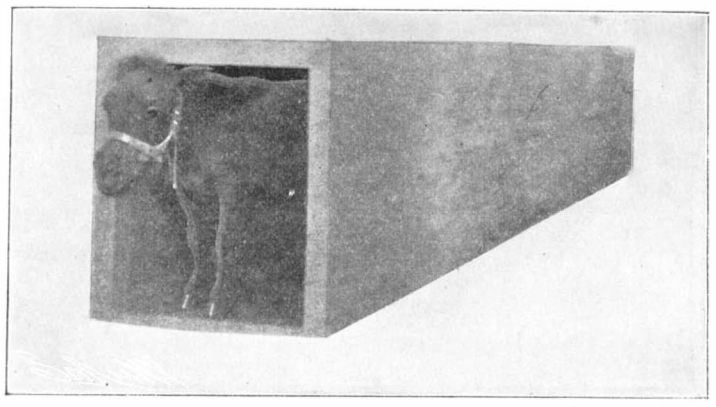
Reed-Actuating Devices.

basis of every melody. The largest metal pipe in the organ is 37 feet in length and 17 inches in diameter. It is made of No. 24 zinc, and weighs 800 pounds. The largest wooden pipe is thirty-two feet long, and is made of 2½-inch Oregon pine. Its proportions are so immense that a Shetland pony was placed inside and photographed. From these two great pipes radiate the 9,998 others, each with its own individual voice and size and personality. Some of them are infinitesimal in size, and produce microscopic voices, scarce more than a sigh or a faint chirp.

In the five manuals there are 61 notes. The key action is of the single-contact system. Each contact in the automatic console has a spark arrester.

It has taken several hundred sheepskins to cover the pneumatics for the chests. A number of girls and women were employed in this department.

A somewhat unsual mechanical device is the application of "double touch" to three of the manuals, great, swell, and choir, by which the performer, by giving from the fingers three times the pressure normally required, may produce three sets of notes that materially magnify the wave of melody.



Shetland Pony in the Largest Pipe (32 Feet Long).

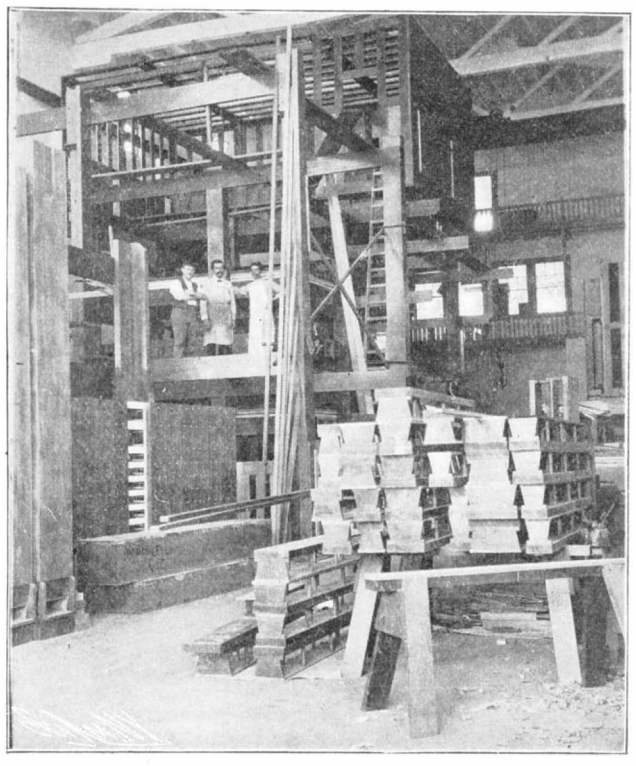
Rare Earths in Oklahoma.

One crumb of comfort the government assayers have for mineral prospectors in the Wichita Mountains district of Oklahoma. The chemists of the United States Geological Survey could find no trace of gold in all the 71 samples from that district that they assayed for the yellow metal. Ten samples were examined for silver, but in only two samples was any indication of silver detected. These showed only 0.14 ounce and 0.92 ounce per ton respectively. In two other samples copper was found, 0.351 per cent in one sample and 10.81 per cent in the other. One sample also showed 3.63 per cent of lead. In these cases, however, the small amount of ore available more than offsets the value. Disappointing as the results of this investigation must be to the people of Oklahoma, some basis for their hope of mineral wealth may be contained in the statement that, although no precious metals were found in the samples examined, discovery was afterward made in one of the samples of the interesting mineral called columbite. It is not known that columbite has any specific value of its own, but its presence is always significant, for it is known to have a fondness for the society of certain minerals that contain rare and valuable earths. Among these is samarskite, the source of thorium, which is in demand for use in the manufacture of mantles for Welsbach lights. Pitchblende, another of these minerals, is the principal source of radium, and shines nowadays with more than usual effulgence in the firmament of mineral substances. It may therefore come to pass that a small quantity of rare earth is worth almost as much to Oklahoma as a large quantity of precious metal. Requests have been made by the survey for other samples from near Roosevelt, the locality whence came the sample containing the columbite.

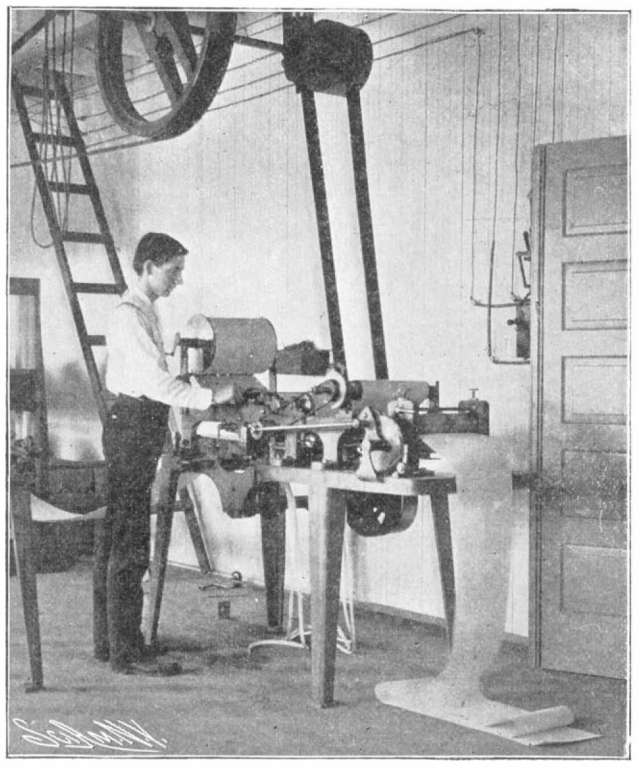
It was Mr. H. Foster Bain, of the United States Geological Survey, who, at the request of the Secretary of the Interior, made a reconnaissance of the Wichita Mountains last fall, with the especial purpose of studying the reported occurrence of ores of copper, lead, and precious metals. He collected a large number of samples, which were carefully assayed by Mr. Eugene T. Allen, chemical geologist of the Survey. In view of the absolutely uniform absence of even a trace of gold and only the occasional presence of a small quantity of silver, copper, or lead, Mr. Bain was forced to report that none of the prospects examined showed any ore in the proper sense of the term, and that none of them had any present or probable future value. He added that it was impossible to say whether future prospecting might not reveal other occurrences which do have value. It is believed, however, that the prospects examined were fully representative and had in many cases been developed enough to allow a proper judgment to be made as to their value. In no case do they offer any encouragement whatever for additional prospecting.

Mr. Bain expects to discuss the matter more in detail in a paper to be included in a bulletin entitled "Contributions to Economic Geology, 1903," which will probably be ready for distribution about May 1. One significant discovery made by Mr. Bain was the occurrence of molybdenite, which would seem to lend some plausibility to the consoling theory that in depriving the Wichita Mountains of the precious metals it could so easily have harbored, Nature made what amends she could and granted them a few rare earths in place of rock-bearing rocks.

The biggest searchlight in the world will be seen at the World's Fair. It was finished in an electric plant at Lowell, Mass. It weighs nearly four tons, is of 5,250,000 candle-power, and projects a beam of light seven feet in diameter.



Part of the Organ's Framework.



Making Automatic Music.

THE GREATEST OF PIPE ORGANS.

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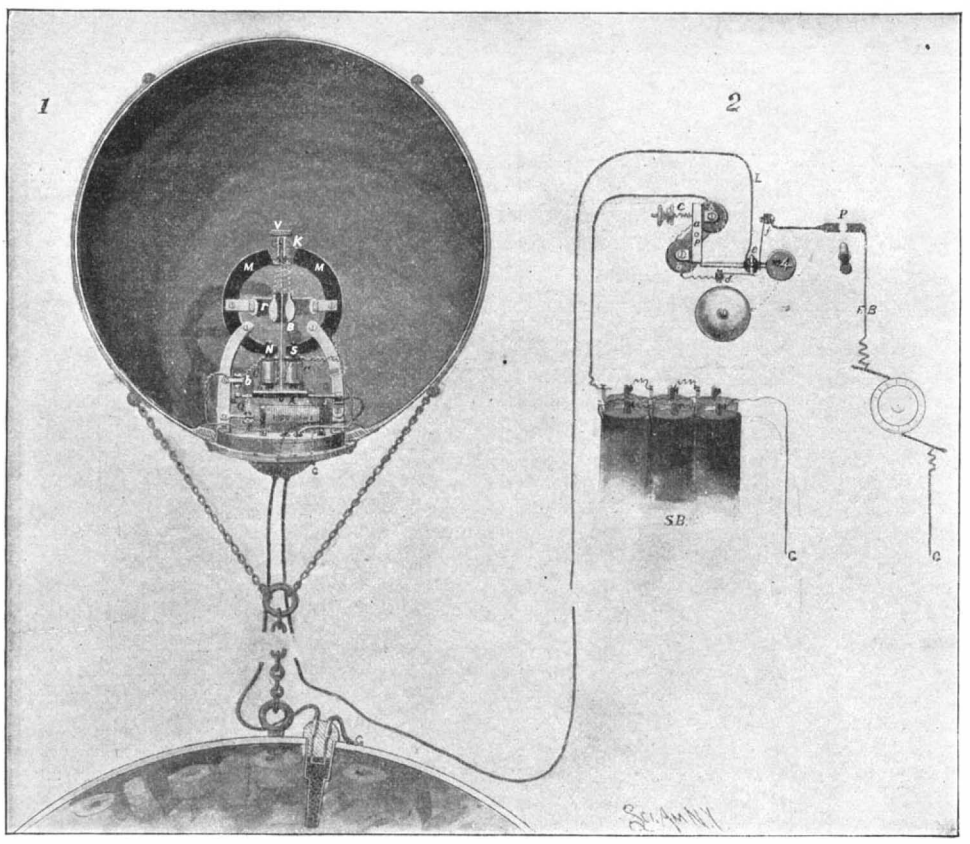
THE SUBMARINE MINE.

In the many attacks that the Japanese fleet has made on Port Arthur, it may have been observed that the larger vessels have never ventured very close to the harbor entrance. Several causes may be assigned for this, such as the danger of plunging fire from the lofty fortifications, the difficulty of maneuvering in the narrow waterway, and the risk of being sunk by torpedo-boat attack. But outside of these dangers there is one which, above all others, will prevent any attempted forcing of the channel by the combined Japanese fleet, and that is the presence of the deadly submarine mine. The moral and material effect of submarine mine attack can scarcely be overestimated. The moral effect is so great, that the mere supposition that a harbor entrance may be mined is usually sufficient to deter the enemy from forcing an entrance; and the material effect of a ship coming in contact with a mine would be either its certain destruction, or its disablement to such an extent that it would have to be beached at once to save it from sinking.

Broadly speaking, there are three different kinds of submarine mines. First, observation mines, which are fired from the shore when a ship is known to be in range; second, automatic mines, which are exploded on being struck by a ship, which is the kind with which the Russians claim that the "Petropavlovsk" was sunk; third, electric-contact mines, which on being struck by a passing vessel give notification to an operator on shore, who fires the mine by the throw of a switch.

Although submarine mines are built in a variety of forms and with different details of their contact and firing mechanism, the two illustrations which we herewith present will serve to illustrate the principles upon which they are built and operated. The mine proper consists generally of a large and heavy hemispherical metal case, which is filled with a charge of high explosive, and contains a fuse which may be fired either automatically or at the will of an observer on shore. They are of two types. Where the water is comparatively shallow, and not too great to interfere with the destructive effect of the explosive, the mine is placed on the bottom and is known as a ground mine. In deeper water it is carried in a buoyant vessel, which is anchored to the bottom, and floats at a pre-determined depth below the surface of the water. The observation mine may be fired by one or two observers; if by one, the mines are laid in lines, which converge to the observation station, and all the mines in each row are connected, so that the operator can fire them simultaneously at the ship passes the range line. When two observers work together it is possible, by a system of cross observation, to fire any particular mine when the ship is passing over it, or sufficiently near to come within the radius of explosive effect. The type most commonly used is the electric-contact mine.

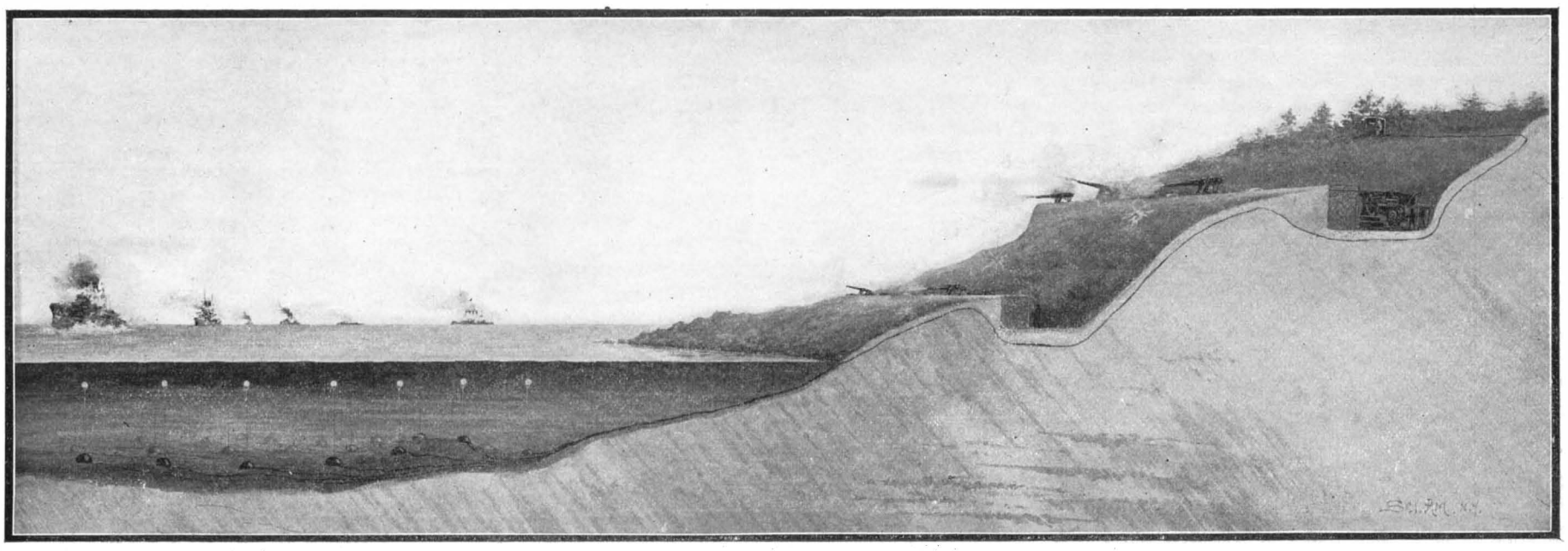
The accompanying illustrations show a system of electric-contact ground mines, laid across a channel, with a battery of rapid-fire guns on shore so placed that they command the whole of the mine field, and render it impossible for the small boats of the enemy to attempt to explode the mines before the big battleships and armored cruisers pass over them. The battery is placed rather low down near the water, and above it is a battery of heavy 8 and 10-inch breech-loading rifles, mounted either *en barbette* or on disappearing mounts, while above these, carefully masked by shrubbery, is a firing station, which is connected by cables with the mines in the channel. Sometimes, by preference, the firing station is placed in a massive concrete casemate, which is built into the structure of the fortification. The submarine mines would be laid out in a series of parallel lines, and so spaced that the mines in each line would cover the spaces left in the adjacent lines, with the result that on whatever course a ship might be steering, she would be certain to strike one or more of the mines before she passed over the field. The ground mine, which, as we have said, is usually a hemispherical metal case, contains several hundred pounds of high explosive, and is held in place on the bed of the river or channel by its own weight, sometimes assisted by heavy hooks cast upon the outer shell. Anchored to the mine, and floating above it, at a depth below water that is less than the draft of the enemy's vessels, is a hollow buoyant sphere in which is placed the electric circuit closer. The upper engraving of the two herewith shown represents a section through the floating sphere, and shows the details of a type of circuit-closer which has been very widely used. It consists of a horseshoe magnet, *M*, *M*, within which is hung by a coiled wire a ball, *B*. A silken cord is hung from the top of the magnet, passes down through the ball, and is attached to an armature, *A*. When the vessel strikes the buoy, the ball is thrown to one side, draws aside the silken cord and lifts the armature, *A*. To the poles, *N*, *S*, of the magnet are secured two small magnets, *C*, *C*, one end of the coil wire being connected to line and the other to a contact point, *b*. The armature *A* is secured by a spring to an insulated point, *P*, from which a wire passes through the firing fuse in the ground mine to earth. The other end of the armature carries a contact point which, when the buoy is struck, engages with a contact point, *b*, which is connected to earth through the interposed resistance of a 1,000-ohm resistance coil.



GROUND MINE, ELECTRIC-CONTACT BUOY, AND SHUTTER AT FIRING-STATION.

Fig. 2 shows the automatic indicator or shutter, which is placed in the firing station on shore. Two currents are employed: One a continuous current of feeble power from a signaling battery, *S B;* the other and more powerful current from a firing battery, *F B*. The arrangement is as follows: Between two electro-magnets, *b b*, is suspended an armature, *a*, pivoted at its center, *p*. The lower end of the armature holds one end of a weighted lever, 4. When a current passes through the magnets the armature is rotated, the end of the weighted lever released, and the weight falls, striking a bell and giving notice to the operator. The weighted lever turns on an insulated axis, which is connected to line, *L*. The insulated axis carries a metallic cross-bar, *e*, which is normally in contact with the spring, *d*, which is itself connected through the coils of the electro-magnet with the signaling battery, *S B*. When the weighted lever, 4, known technically as the "shutter," falls, this spring is disconnected by the rotation of *e*, and the firing battery, *F B*, is brought into play through the contact of plate, *e*, with spring *f*, that is, supposing the plug *P* is in place. By leaving *P* normally out of place, the observer can fire the battery at will by inserting the plug.

Now let us follow more closely the operation of blowing up the hostile ship. The instant the vessel strikes the buoy, the suspended ball, *B*, swings to one side, draws aside the cord, pulls up armature *A*, into contact with *b*, and causes the signal-battery current to pass by way of the 1,000-ohm resistance-coil down through the ground fuse to earth. This current is too weak to ignite the fuse. At the same time the armature, *a* (in the firing station), is attracted to the magnets, *b*, *b*, and releases the pivoted shutter, 4, ringing the bell and throwing the signal battery line *L* into circuit with the line to the firing battery, *F B*. The operator now places the plug, *P*, in place, and sends the whole force of the main current into the line, and as this has sufficient force to pass the resistance and ignite the fuse, the ground mine is instantly exploded. In the case of an automatic mine of the kind that is claimed to have sunk the "Petropavlovsk," the instant the floating sphere or case is struck by the ship, there is an explosion of the charge, which is carried in the floating case, if the water is very deep, or in the ground mine at the bottom if the water is sufficiently shallow to bring the mine within striking distance of the ship's bottom.



Field of ground mines, showing submerged electric-contact floating buoys attached.

Rapid-fire battery to prevent countermining.

Battery of 8 and 10-inch disappearing guns.

Firing station and range-finders.

METHOD OF DEFENDING HARBOR CHANNEL WITH SUBMARINE MINES AND BATTERIES OF RAPID-FIRE AND HIGH-POWERED GUNS.

Fifty-five towns or villages in Germany are artificially illuminated by acetylene gas, and the total length of the mains is 145 miles. The price of the gas varies between 1s. 6½d. to 2s. 3d. per cubic meter.

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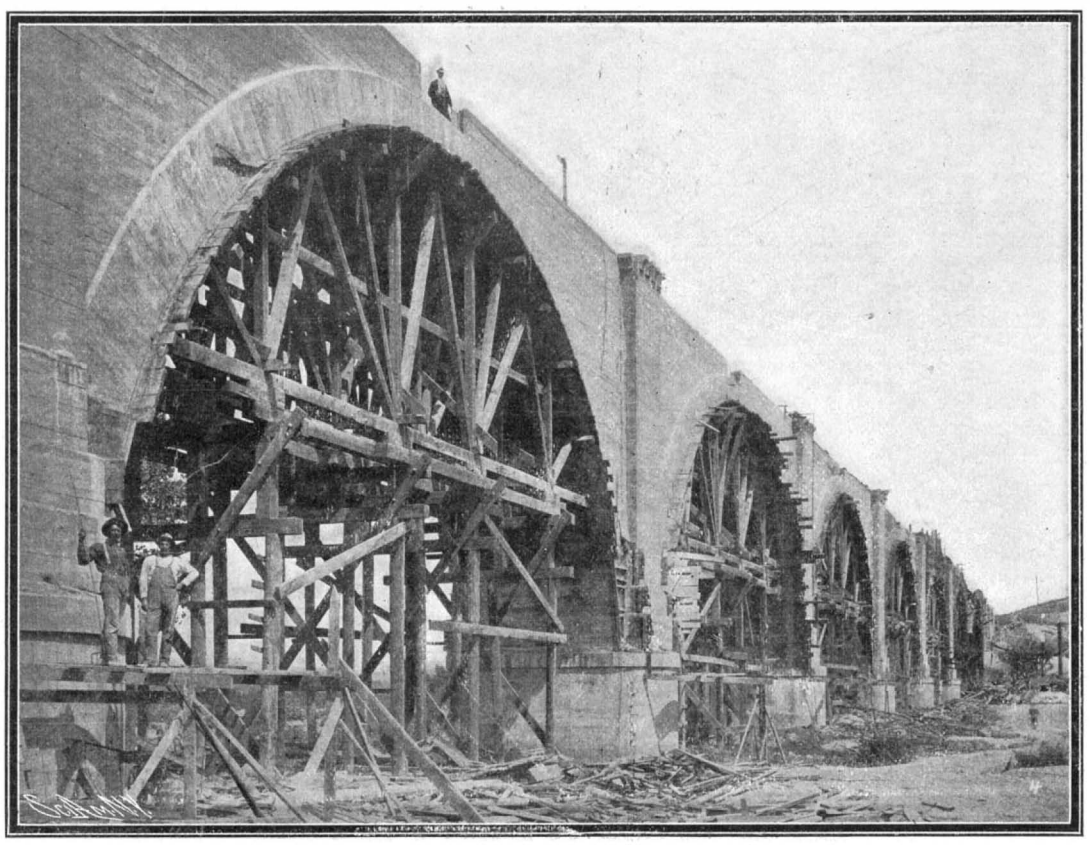
CONCRETE RAILWAY BRIDGES.

The increasing use of concrete in construction work of the most varied kinds is well illustrated by the instances given below of building railway bridges of concrete.

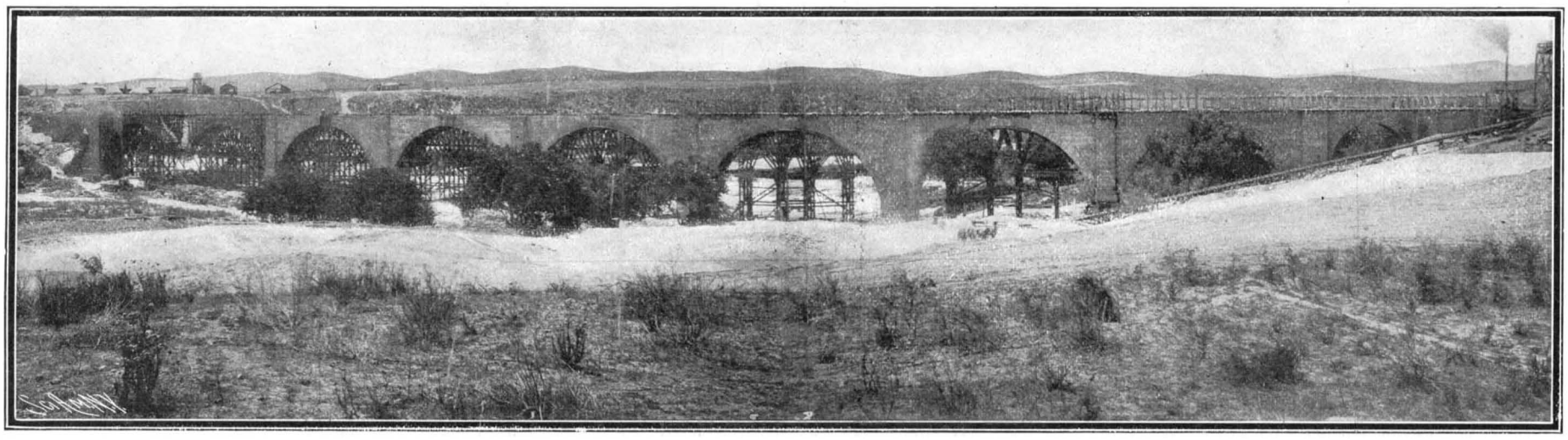
It is a curious fact, and characteristic of the recent rush of prosperity in the iron and steel industry, that the largest concrete railroad bridge in the world, herewith illustrated, should owe its existence to that prosperity. This bridge, which is now under construction for the San Pedro, Los Angeles and Salt Lake Railroad Company, carries the tracks across the Santa Ana River, at a point some four miles from Riverside, Cal. As originally planned, the bridge was to have been built of steel; but when it came to placing the contract for the same, it was found that the great rush of work in the various bridge-building establishments of the country had thrown them several months behind their orders. Rather than undergo the serious delay that would result if the bridge were built of steel, the chief engineer of the road determined to go ahead and build the structure at once of concrete, the materials for the manufacture of which were readily available, and the nature of the building material being such that it could be prepared immediately.



Looking Southeast Along the Santa Ana Viaduct.

The viaduct, which has a total length of 984 feet, consists of ten arches flanked by two massive abutments. Eight of these arches have a clear span of 86 feet, and the two end spans adjoining the abutments are about 35 feet clear span. The piers measure 14 feet by 28 feet in plan, and are built of solid concrete. The arches are semicircular, and the greatest height of the structure above the river bed is about 70 feet. The excavations for foundations were carried down to bed rock, which was found at a depth of from 12 to 30 feet, the excavation being done by means of coffer dams. The estimated weight on each foundation is about 1,050 tons. But little difficulty was experienced in finding satisfactory bearing material, except in the case of the last pier, which, after the work had been carried up to a height of 20 or 30 feet, began to show signs of settlement. The matter was remedied by driving cement grouting into the material below the foundation, the grouting being forced in by means of pumps. After the piers had been carried up to the springing of the arches, the falsework and centering were erected, the outer timber form built up, and the concrete rammed in place. The concrete was prepared in a large mixer located near one of the abutments, from which it was loaded into cars and hauled to the particular part of the work where it was needed. The design of the bridge is simple, and suitable to the character of the structure, plain rectangular pilasters running from the piers between each arch to the parapet line, where they are relieved by a series of corbels. It will be seen from our illustration that the concrete construction harmonizes well with the natural characteristics of the country.

Another notable concrete structure is the double-track bridge which the Illinois Central has recently completed over the Big Muddy River, near Carbondale, Ill. This is remarkable from an engineering standpoint, because its arches are the longest of the kind ever constructed. The bridge consists of three 140-foot spans, the limit hitherto having been about 90 feet. The total length of the bridge is 574 feet 6 inches, and width 34 feet 2 inches. In the construction of the three centers for the elliptical arches, the fan-shaped grillage was supported on three rows of piles. The rise of the arches is 30 feet. About 12,000 cubic yards of concrete were used in the structure, which cost $75,000. This is less than the cost of a modern double-track steel bridge of the same dimensions. This type marks an era in railroad bridge construction, as the Illinois Central is replacing all wooden and steel structures, where replacement is necessary, with concrete bridges when conditions permit of so doing. The credit of constructing concrete arches of such length belongs to J. F. Wallace.



Santa Ana Viaduct at Riverside, California; 984 Feet Long.

CONCRETE RAILWAY BRIDGES.

Count Zeppelin's Experiments.

In a letter addressed to the National Zeitung, Count Zeppelin states that his appeal to the German public had not met with the response he anticipated, but that by the aid of several subscriptions he had succeeded in raising the sum of 16,000 marks ($4,000) for the construction of a new airship. To aid in the new project, the leading German constructors will furnish him with the necessary material at a greatly reduced price. Under these conditions, and seeing that the Minister of War, as well as the King of Wurtemberg, have offered him their support, Count Zeppelin has decided to begin the construction of his new airship. After a careful study of the subject since his last trials over Lake Constance, he expects to bring out a greatly improved airship. According to reports, an immense balloon shed is to be erected near Manzell, on the lake, from which the trials are to be held.

A dispatch has been received from the British vice-consul at Sevastopol, reporting that the Russian government had decided to construct an electric railway between Sevastopol and Yalta, to pass *via* Balaclava, Bida, Aloupka, and Livadia.

Mining Ore in the Mesabi District.

BY KIRBY THOMAS.

In the Special Iron and Steel Number of the SCIENTIFIC AMERICAN reference was made to the rich Mesabi iron deposit in Northern Minnesota, as being one of the chief contributory causes of our supremacy in the iron and steel industry. This range was first opened in 1893; since which date it has produced 66,800,898 tons of iron ore. In 1902 nearly 45 per cent of the total iron output of the Lake Superior district came from the Mesabi range, or 33 per cent of the total iron ore output of the United States, the greatest iron-producing country in the world. In 1903 the Mesabi district produced 53 per cent of the Lake Superior output.

Owing to the shallow nature of the ore deposit and the soft character of the ores, it has been found possible and economical to mine this Mesabi ore with steam shovels in open cuts, and it is on this range that this method of mining is developed to a remarkable extent. The ore lies in broad basins in the rock, covered with glacial drift from a few feet to 100 or more feet thick. The method of mining most used is to strip off the overburden of gravel and load the ore direct into steam cars with steam shovels for transportation to the lake ports. A steam shovel will load 2,000 cubic yards of gravel in twenty hours, and considerably more ore. A fair output in ore for a steam shovel is 75 cars of 25 tons capacity in ten hours. The cost of "stripping," as the process of removing the gravel is called, is about 40 cents a cubic yard, and most of this work is done by contract. The cost of removing 40 feet of gravel from an acre then would be $16,000. The ore can be mined and put on the tracks for less than 5 cents a ton, to which must be added the distributed cost of the shipping and general management.

The work of excavating the ore is carried on in parallel benches, the ore being scooped up directly from the natural bed and loaded into the adjacent train of cars. The rich, loose ore in the richest mines will run over 60 per cent of iron to the ton. Several of these mines shipped last year over a million tons of ore each, and the total shipment of ore reached thirteen and a half millions in 1902 and almost as much in 1903. A number of the Mesabi mines are worked by the underground methods, but it is as an example of steam-shovel mining that the range is known the world over.

Carrara Marble.

Carrara marble, which is of universal repute, is produced in Italy. The strata from which 319,887 metric tons were quarried in 1902, partly for export to America, cover an area of 80 square miles, and reach in places the depth of three-quarters of a mile. The mines, some of which were worked by the Romans, are surface workings, at an altitude of 700 to 3,000 feet above sea level.

More than two hundred kinds of rice are shown in Siam's agricultural display at the World's Fair.

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A FIRE ESCAPE FOR TOURISTS AND TRAVELERS.

BY W. G. FITZ GERALD.

The problem of the sky-scraper hotel is a very serious one for the traveling public, but it seems to have been solved in a very ingenious manner by an Englishman after a brief, but scared, visit to this country.

Lying in his bed at night on some incredibly lofty floor, he read all kinds of uncheerful things about fierce conflagrations that have devastated entire cities. He wondered whether there was no way of sleeping in peace and comfort of mind, even on the twentieth floor, with an infallible fire escape at the foot of his bed, thus rendering him absolutely independent of extraneous assistance.

He went home and devised the ingenious traveling-bag escape, shown in the accompanying photographs. This will cost, at any bag and trunk maker's, very little more than an ordinary portmanteau of the same kind; and moreover, the fire escape part of it does not interfere to any extent with its capacity for holding your dress suit, boots, shirts, or a hundred and one other things requisite for the traveler.

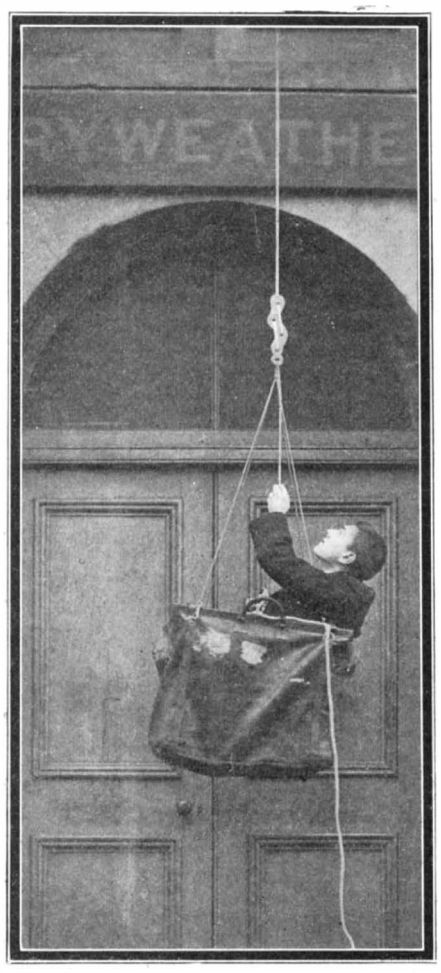
In one small compartment will be found some hundreds of feet of that fine, light rope used by mountaineers in the Swiss Alps, for roping themselves together while crossing glaciers and climbing precipitous ice slopes. There is also a particularly ingenious little brake arrangement, and two pairs of steel snap hooks. That is all, but it certainly enables the possessor of this useful article of baggage to rest easy in his bed in an American sky-scraper hotel.

Let us suppose that an alarm of fire is given in the dead of night, and the flames cut off every means of communication with the outside. Well, the possessor of this portmanteau fire escape simply slips out of bed, snaps one set of hooks round the bed leg or other substantial piece of furniture, and the other set to the sides of the portmanteau. This last he then throws out of the window, gets into it himself, and then lowers himself just as quickly or as slowly as he pleases by means of the brake. This useful article of baggage has not yet made its appearance in this country, but beyond question it will do so pretty speedily.

THE PORTMANTEAU FIRE ESCAPE.

Carbureted Air Light.

Dr. Hugh Marshall, fellow of the Royal Society of Edinburgh, lecturer on chemistry in the University of Edinburgh, has invented another method of using carbureted air for lighting. It is an improvement upon the form of lamp devised by M. Naum Notkin, of Moscow, in which carbureted air was obtained by employing paper pulp saturated with gasoline to produce the vapor required. In this Notkin "gravity" lamp the carbureted air, being denser than air itself, flowed from a higher to a lower level, instead of ascending like coal gas, and could therefore be poured from one vessel to another, like a liquid. In the Marshall lamp the necessary current of air through the carbureter is not maintained by the effect of gravity, but by means of the draft from the lamp chimney. It is thus possible to have the body of the lamp below the actual burner. To reduce the manipulation necessary with such a lamp when used in incandescent lighting, Dr. Marshall has invented a form of burner tube, which is sunk axially into the body of the containing vessel, and which enables the user to regulate the mixture of vapor and air to a nicety by simply rotating the tube in one direction or the other. The new method of using carbureted air has been applied by Dr. Marshall to various types of lamps—table and portable, hanging, basket, and also in lantern form for outdoor lighting. These show a brilliant incandescent light, without any liquid or wicks being used, and are free from smell or smoke. Dr. Marshall claims also that carbureted air can be supplied all over a house without danger or complicated processes, and that the gas can be applied to other purposes than lighting, such as for heating and motive power.—Rufus Fleming, Consul, Edinburgh.



THE FIRE ESCAPE IN USE.

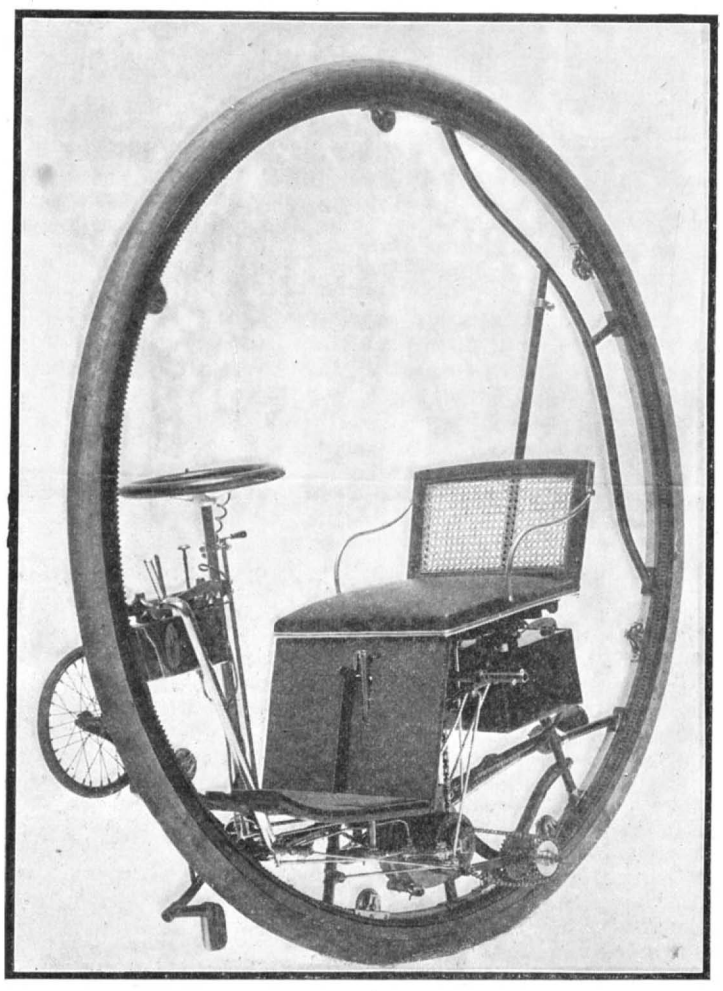
A NOVEL ITALIAN UNICYCLE.

BY EMILE GUARINI.

The accompanying engraving illustrates a motor unicycle invented by Signore Lilio Negroni and constructed by the Garavaglia establishment of Milan. At the last exposition of automobiles, at Turin, it was one of the greatest attractions. In the motor unicycle, the motor and the cyclist are mounted within a single wheel. The object of the inventor in ordering the construction of this strange vehicle, which appears to be the first practical application of a theoretical principle, was, according to him, to offer to cyclists the marked advantages, from the viewpoint of convenience, safety, economy, and even esthetics, over the ordinary motorcycles. The Negroni unicycle consists of a laminated steel hoop provided with a pneumatic tire and designed to revolve upon the ground. A circular frame is arranged concentrically within the hoop and carries the motor and the seat for the cyclist. The frame, motor, and cyclist together, when the hoop revolves upon the ground, move along over the latter just as does an ordinary motor bicycle. In its rotating motion around the circular frame, the hoop is guided by a system of small wheels distributed and fixed in the periphery of the frame and bearing constantly against the internal surface of the hoop. The mechanical reaction necessary for starting and driving the vehicle is obtained from the weight of the frame, the motor and its parts, and the cyclist. The motor drives through a friction clutch, by means of a chain and sprocket, a gear wheel mounted on the frame, and this gear engages with an internal gear fixed to the hoop. The friction clutch allows of starting the motor independently of the hoop, and of transmitting motion to the latter by degrees and without shock.

The steering of the unicycle is very sensitive. In fact, in order to make it turn to one side it is merely necessary for the operator to displace the center of gravity by swaying his body. Despite this, and in order to make the control of the vehicle still easier, the inventor has provided it with a small handwheel, the turning of which displaces the seat and rider to one side or the other. The brake is provided with an automatic arrangement that prevents the motor and the cyclist's seat from becoming locked to the external hoop and thus being carried along by the latter in its rotary motion.

Signor Negroni does not conceal the fact that his apparatus is not yet free from defects, although these may be successively eliminated by appropriate modifications of each of the parts of the vehicle. He thinks, too, that after his unicycle has been sufficiently improved, it will possess over ordinary motor bicycles all the advantages mentioned above. However this may be, the trials of it that have so far been made have from every point of view, given excellent results. They permit of the assertion that, although the vehicle may not have an extensive practical application, it will at least always remain an ingenious, curious, and interesting apparatus.



A UNICYCLE DRIVEN BY A GASOLINE MOTOR.

Gilsonite and Elaterite—How Used.

The uses to which gilsonite and elaterite are put are varied. There is a big shortage in the world's supply of vegetable rubber, and these hydrocarbons are now taking its place. They are made into a mineral rubber that unites perfectly with tree rubber, thus permitting a very large reduction in the amount of the latter used, and cheapening its cost materially. Second-grade gilsonite is used for paving cement by melting it with petroleum residue and mixing it with ground asphaltic limestone and the requisite amount of sand. Gilsonite is also manufactured into varnishes, lacquers, waterproof paint for gun carriages, and steel and wood work of every description known to ship building; as a paint for ship bottoms, it prevents barnacles from attaching themselves. It is also used for pipe coatings, reservoir coatings, floorings, roofings, and railroad work. The following is a further list of some of its uses: For coating barbed-wire fencing; coating sea walls of brick and masonry; coating paving brick; acidproof lining for chemical tanks; roofing pitch; insulating electric wires; smokestack paint; coating poles, posts, and ties; lubricant for heavy machines; covering wood-block paving; binding pitch for carbon in making coal briquettes.

Elaterite is being largely used now to make flexible and heatproof varnish and paints, which are excellent for coating shaft and tunnel timbers, for painting hemp and wire hoisting ropes, pump columns, pipes, chains, ore cars, and all steel and iron work where the surfaces are exposed; also for coating vats, tanks, and pan covers used in chlorination works, smelters, and refineries, and in the cyanide process. On ironwork it prevents corrosion and resists great heats. On woodwork it prevents absorption, and defies the elements.—Mines and Minerals.

An improved railroad crossing has recently been patented by Mr. J. H. Higgins, of Wanatah, Ind., that is said to be a great improvement over the crossings now in use universally. The invention provides for continuous frog intersections or steel filler blocks, slightly elevated at the place of crossing, so that the wheels are carried for a short distance on the flanges, instead of on the wheel proper. As this carries the wheel slightly above the track, the usual bumping caused by the break in the track is eliminated. This is very desirable, as everyone knows how annoying it is to go bumping over a crossing, and especially over one that has been in use for some time. This improvement is also said to be very valuable because it materially extends the life of a crossing, as shown by experiment. Several railroads are already adopting this device.

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Legal Notes.

THE GRANT AND VALIDITY OF BRITISH PATENTS FOR INVENTIONS.*—Very few persons, whose inventive rights are protected under the patent laws of the different countries, realize the many provisions which are necessary to afford them protection in each case, and the special training which it is necessary for the solicitor or lawyer in charge of their interests to have, in order that the actions of the public and the courts may be anticipated, the full protection of the invention be secured, and the patent be sustained during the many possible contests and the litigation which may arise during its term. For a lawyer to familiarize himself with the patent laws of any country requires long and careful study; and when he has not brought to his task a special training in the arts or an aptitude for this branch of learning, he will find a further difficulty in applying his knowledge to the facts in particular cases as they may arise. Mr. Roberts has the several qualifications which are necessary for the writer of a review of the patent law of Great Britain, and in the book before us he has shown himself fully able to cope with a task, the results of which are now offered to the public.

The work has been treated in a novel way, for there are only one hundred and seventy-eight pages of text in the book, while the principal portion of the work is devoted to abstracts from cases which have been selected by the author. The space given to the text being so limited, it is little more than a very brief digest of the cases which form the body of the book and give to it its value. While a law book should in every case use the language of the decisions in which the law is construed, it aids very much to a review of the law to have together all the matter relating to a certain subject. To be sure, when a question of importance is to be considered, all the cases in which the same facts appear should be reviewed, but that will be impossible in a single volume, the purpose of which is to furnish the general information which is necessary to the avoidance of the many pitfalls which the uninitiated finds in his path. Mr. Roberts states that this book was written from the point of view of inventors. It is therefore to be regretted that he did not make it more of a constructive work, instead of confining himself in most of the pages to abstracts of cases, which it is impossible to arrange in any order, because most of the decisions discuss two or more questions. While many inventors will probably refer to the book and use it to advantage, the work will also be found on the shelves of many lawyers' libraries, and patent solicitors, especially those in foreign countries engaged in British patent practice, cannot very well afford to overlook the assistance which is now offered.

In preparing specifications to accompany British applications, the same care is necessary to describe and disclose the invention correctly as is required in the preparation of specifications which are to be filed in the United States Patent Office; but, because of several differences in the British patent laws and practice, many things must be examined which the applicant for a United States patent need not consider with the same care. Under the old law, the British Patent Office does not examine as to the novelty of the invention, though when the amended law goes into effect, an examination will be made of British specifications which were deposited in the matter of applications filed within fifty years next before the filing of the application which is being considered by the officials. It will be seen that under the old law, the British Patent Office offers the applicant no assistance in the limitation of his claims to that to which he is entitled in view of the state of the art, and that even under the practice which will go into effect some time in the future, very little assistance will be rendered to the applicant by the examiners in the Patent Office. It is therefore necessary for the applicant to inform himself at his peril what his invention is, and to limit his claims to what is new, for under the British practice a patent is invalid in which there is one claim to which the patentee is not entitled. This severe rule of law, with the other provisions as to the novelty of an invention, which make it necessary for the applicant to file his patent application before the invention has been publicly used in Great Britain, or has been published in that country, makes it often extremely difficult to confine the claims to the features of the invention which it will be impossible for opponents to attack on the ground of a previous use or publication. Very many British patentees have been unable to obtain recognition of their rights in the courts on this ground alone, though, in the decisions to which Mr. Roberts refers, quite as many patentees have failed in their efforts to protect their inventions, because when the complete specification was being prepared, there was great uncertainty in the mind of the solicitor as to what the inventor desired to protect.

Another line of decisions considers the question of disconformity. Except when a British patent application is filed under the International Convention, it is possible for the applicant to leave with his application a provisional specification in which the invention is generally and fairly described without disclosing the mode of carrying it into practice. When a provisional specification is filed with a patent application, the applicant has nine months in which to file a complete specification in which the nature of the invention is particularly described and ascertained, and the manner in which it is to be performed is stated. Disconformity is the inclusion in the complete specification and claims of that which was not mentioned or that which is not a fair development of that which was mentioned in the provisional specification. When the complete specification is held to "disconform" to the provisional specification, the patent is invalid.

There is much substance in the book, and by a careful review of the selected cases with the notes, which the author from time to time has added, a good working knowledge of the British patent practice can be obtained. In the back of the book will be found the Patent Acts, with the authorized forms and official circulars of information. The volume also contains a very good index, in which the questions considered in the different decisions are arranged in their proper order.

* The Grant and Validity of British Patents for Inventions. By James Roberts. London: John Murray. New York: E. P. Dutton & Co.

THE CONSTRUCTION OF CLAIMS.—A patent was issued to Joseph Boyer on April 16, 1895, for a pneumatic tool, the various features of which are expressed in a large number of claims. Suit was brought by the patentee against the Keller Tool Company for infringement of this patent. The bill was dismissed by the Circuit Court and an appeal taken to the Circuit Court of Appeals (127 Fed. Rep., 130).

The only complaint with which the Appellate Court had to deal was the treatment of those claims covering the means for controlling the supply pressure. Claim 47, as expressive of this group, was held by the Circuit Court to call for a pressure supply duct which extended to the grasping portion of the handle, combined with a throttle valve to control the supply. None of these appeared in the tool manufactured by the defendant, for which reason the charge of infringement was dismissed.

In reversing the decision of the lower court, the Circuit Court of Appeals took occasion to enumerate the rules which should be observed in the construction of claims. In this Boyer patent the mechanical elements combined were old; but the combination itself showed patentable invention, especially in view of the utility of the tool and its superiority over those of the prior art.

Much was made in this case of the effect of the proceedings in the Patent Office as disclosed by the file wrapper. The court accepted for the purposes of the case all that could be legitimately claimed for the argument of counsel addressed to the examiner which is there found. The court thought that the claims of a patent are not narrowed by statements made on an argument before the Patent Office to obtain a reconsideration after the application has been rejected, where no changes are made in the claims.

In many specifications a certain part of a mechanical combination is said to consist preferably of the shape approximating that shown in the drawings, but the inventor expressly declares, with regard to his invention generally, that by describing in detail any particular arrangement he does not intend to limit himself beyond the terms of his several claims or the requirements of the prior art. Under these circumstances, the court held that a claim is realized and infringed by any construction of the general character called for which fulfills its terms, notwithstanding the words "substantially as described" at the end.

A TRADE-MARK INFRINGEMENT SUIT.—The case of Ohio Baking Company vs. National Biscuit Company (127 Fed. Rep. 117) brings out a typical trade-mark situation and a typical decision. Complainant's "In-er Seal" trade-mark, as known to the public, was printed in white letters on a vivid red background of a peculiar shade, and applied to the ends of cracker and biscuit cartons, in which complainant's goods were packed for sale. Shortly thereafter defendant conceived a trade-mark with the words "Factory Seal" printed on the same-colored labels, which it applied to the ends of similar packages of its biscuits. At the time defendant adopted this trade-mark it knew complainant's crackers were the only ones sold with the red seal on the end of the cartons, and that its trade-marks were liable to deceive careless purchasers. The court held that defendant's trade-mark, when so printed and used, was an infringement on complainant's trade-mark, and should be enjoined.

Brief Notes Concerning Patents.

Rev. Ernest d'Aquila, pastor of the Italian Roman Catholic church of Our Lady of Mount Carmel, Newark, N. J., has been granted a patent on a safety gas burner, which is intended to prevent the asphyxiation of persons who blow out the light either by design or accident.

Dr. Hans Goldschmidt, the German chemist, who has been visiting this country, took occasion during his stay to inspect the furnace invented by Marcus Ruthenberg, of Philadelphia, by which the highest grade of steel is made directly from the ore. This furnace has been erected at the Cowles Aluminium Works, at Lockport, N. Y. A practical demonstration of the furnace was given for the distinguished visitor.

Dr. Von Adelung, the health officer of the city of Oakland, Cal., has invented a new faucet which is being experimented with by the board of education of that city. By the use of this device, the doctor claims it will be impossible to transmit disease germs from one scholar to another. The faucet is much like others, except that it is inverted and does away with the use of the drinking cup.

Ethan R. Cheney recently died at Brookline. He was an inventor of note. For twenty years he was master mechanic at the Norway Iron Works, in Boston, and while there invented and patented many valuable pieces of machinery. Four years ago he invented a lathe for the purpose of turning the large granite columns required for the cathedral of St. John the Divine in this city. The columns were 60 feet long and 6 feet in diameter in one piece. The lathe weighed 140 tons and was the largest ever built for turning granite.

An elaborate electrical device, which combines the moving picture machine with the phonograph, so that the words and music of a theatrical or other performance can be heard while the movements of the players are reproduced before the eyes, has been invented and is being exploited. The machine is the invention of T. F. Solon, an ex-member of the Wisconsin legislature, and ex-Gov. George W. Peck, of the same State, is an active member of the company which is engaged in introducing the apparatus. One of the novel features of the machine is the mode by which a cylinder which has become exhausted is automatically changed for a fresh one.

Anyone who has ever witnessed the operation of fighting a fire must have been impressed with the awful force of the water as it issues from the nozzle of the hose. The services of three and four firemen are often required to hold and direct the stream, and it is a frequent occurrence, at that, for the nozzle to break away from their grasp, and under the influence of the mighty force of water being driven through its interior, be hurled right and left, like a mighty serpent on a rampage, seriously injuring anyone who might be unfortunate enough to get within its reach. The only way which the rearing and tearing monster can again be secured is by stopping the pump, and much time is frequently lost before this can be done. A new nozzle which can be handled as easily as a child is just now being brought to the attention of the fire departments of the country. Its remarkable behavior under the highest pressures is attracting the wonder of the men who thought the old nozzle, which has been in use so long with all its faults, was about as near perfect as it was possible to make it. A trial of the device was made recently in New York, when one of the nozzles was connected with three streams, each 2½ inches in diameter, with a pressure at the pumps of 160 pounds. The machine was bolted to a plank, and the latter was nailed down with seven tenpenny nails, and this was entirely sufficient to hold the nozzle under all circumstances. One man could easily direct the stream to any desired point, and after it had been placed as desired, the nozzle remained unsupported without the least variance under the pressure of the water. The upper part of the device consists of a nozzle much the same as is in use at present except that it is finished at the base with a ball joint. The ball end is supported by a stand, which divides at the top to receive and support the end of the nozzle proper, and the stream being divided enters the tube of the nozzle from both sides, which comprises the essential feature of the device. One would naturally conclude that the efficiency of the stream would be impaired by its passage through the two channels, but at the lower pressures there was no change whatever as compared with the ordinary nozzle, while at the higher pressures the difference was very slight. There are several types of the apparatus, and the one tried in New York was the one designed for the heaviest work. Those which are made for handling a single stream of ordinary dimensions are supplied with a stand, which is meant to be merely placed on the ground without any fastenings whatever. When it has been thus located, it needs no further attention, except when it is desired to make a change in the direction of the stream occasionally.

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RECENTLY PATENTED INVENTIONS.

Electrical Devices.

INSULATOR.—J. A. Hanson and A. F. Lambert, Davenport, Wash. This invention relates to insulators, more particularly of the type used upon wire fences where it is desirable to employ one or more of the fence-wires, for the purpose of telephoning, telegraphing, etc. The dielecric may be made of porcelain, clay, china, or other brittle materials, and the staples may be rapidly secured upon the same by any farm laborer.

CURRENT-REGULATOR. — E. Dysterud, Monterey, Nueva Leon, Mexico. The object of this invention, which relates to automatic current-regulators, is to produce a neat, simple, and efficient form of regulator which will require a minimum of attention and which is not liable to get out of order. The instrument works best where the variations in current strength are comparatively light; but it may be nevertheless used to advantage whether the variations are considerable or are abrupt. It also serves to render the potential of the current being generated substantially constant.

Hardware.

NUT-LOCK.—J. F. Rieman, Goshen, Ind. The aim of this invention is the provision of a simple nut-box that may be easily applied and removed, that effectively holds a loose nut, permits of convenient release for tightening the nut against an object, takes up no available room, is perfectly reliable in service, and that may be produced at low cost.

WIRE-ROPE CUTTER.—M. T. Wolf, Washington, Pa. Mr. Wolf's invention relates to means employed for drilling deep wells to obtain water, gas, or oil. The intention is to provide a cutting device that may be conveniently lowered in the well-bore and by its impact on the drill-holder be caused to cut the wire rope that has been connected with the drill, and thus permit the removal of the rope.

Machines and Mechanical Devices.

ROLLER-BEARING.—R. F. Bower, Lima, Ohio. The object in this improvement is to provide a construction of bearing which will be useful wherever a journal-bearing is desired and will be especially useful in such bearings as are designed to permit lateral motion by allowing the shaft or journal to slide laterally in the bearing. It may be used in car-axle boxes or line shafts, stationary machinery, propeller-shafts, and wherever a journal-bearing is employed.

MAGNIFYING ATTACHMENT FOR SEWING-MACHINES.—Sallie Jones, Glasgow, Ky. This device will facilitate the setting, threading, or adjustment of the needle, etc. Persons having defects of vision find it almost impossible to make adjustments and extremely difficult to even thread the needle. The purpose is to overcome these difficulties and permit any one to make the most delicate adjustment of the needle, thread it, and see that the sewing is properly executed.

CASH-REGISTER.—J. C. Vahjen, New York, N. Y. Mr. Vahjen's purpose is to provide a positively-acting construction whereby as each lever-key is depressed a corresponding tablet will be displayed and remain so until another key is operated, each key returning automatically to normal position on release. Also to provide means whereby a key must be fully depressed at each operation to discharge a printed check of amount, which check is cut from a roll of tape and drops from the machine with a display of the tablet. When a key is partially depressed it cannot be forced to normal position before pressed downward to the limit of its travel. Mr. Vahjen has invented another cash-register which relates to a printing mechanism for registers operated by key-levers, which mechanism is particularly designed to print in duplicate and when desired to operate in conjunction with a knife adapted to cut one of the printing tapes or ribbons into checks for delivery from the machine, while the other printed tape remains concealed within. The purpose is to provide a construction of printing attachment applicable to any key-lever-operated machine.

AUTOMATIC PIANO-PLAYER.—H. Meyer, New York, N. Y. The object of the invention is to provide an automatic player for a piano, organ, or like key-actuated musical instrument arranged to permit convenient varying of the speed of the note-sheet traveling over the tracker-board to actuate the key-strikers with more or less force, to keep the note-sheet in proper alinement with the tracker-board, and to quickly reroll the note-sheet.

SAWING-MACHINE.—E. H. Hoff, Mosinee, Wis. The invention relates to improvements in sawing-machines for felling trees, sawing stumps, or the like, an object being to provide a machine of simple construction that may be easily carried from place to place, that may be operated with comparatively little manual exertion, and in which the saw may be arranged for operation at any desired angle.

Pertaining to Vehicles.

STEAM-SLEIGH.—J. R. Tibbits, Delmar, N. Y. The invention consists in effective means whereby the sleigh may be guided. The propelling means and the guiding means are thrown into and out of engagement with the snow or ice by levers extending up within reach of a person sitting on the sleigh-seat. The guiding means has the further advantage in being adapted to be used as a brake.

Prime Movers and Their Accessories.

RELIEF-VALVE.—S. O. Brune, Mine Centre, Canada. In this patent, the object of the invention is to produce a simple, efficient, and reliable device adapted to be easily and quickly applied, capable of a quick action when pressure is admitted, so as to minimize leakage of steam, and susceptible of regulation to adjust itself to different steam-pressures.

HOT-WATER COOLER.—J. S. Scott, Brantford, Canada. In the present invention the aim is to provide a new and improved hot-water cooler, more especially designed for use in connection with the water-jacket of an explosive-engine or the like and arranged to insure a quick cooling of the water to keep the cylinder cool at an approximately uniform temperature.

Of General Interest.

ENVELOP-CLASP.—A. De Saint Chamas, Chicago, Ill. In carrying out this invention Mr. Chamas has particularly in view the provision of a clasp or fastener which will securely seal an envelop or similar receptacle in such manner that the latter may be quickly and rapidly opened by the postal authorities or other persons to permit the contents to be inspected and such envelop then to be readily closed and sealed again. The clasp or clip embodies features of simplicity, durability, lightness, and strength in addition to convenience in use—that is to say, the clasp may be readily adjusted and removed, while at the same time it will form a safe and reliable closure.

COMBINED HYDROMETER AND SYRINGE.—R. Van Benthuysen, New York, N. Y. The purpose here is to prevent hydrometer-tubes from touching the side walls of syringe-barrels and to provide means whereby to prevent rotary motion of the hydrometer in the barrels. And further the purpose is to so construct the scale section of the hydrometer-tube that it will be polygonal in cross-section, having a reading upon one face, for example, indicating density, upon another face degrees Baumé, and upon the third face a reading setting forth a required percentage of liquid to bring the solution tested to proper density.

CABINET.—W. B. Altick, Lancaster, Pa. Briefly stated, the invention comprises a rigid framing furnishing the top, bottom, and back wall of the cabinet and two arc-shaped sections which are arranged to slide between the top and bottom walls, so as to extend outward to meet at their front edges and close the cabinet or so that they may be folded back apart from each other, thus opening the cabinet completely. The invention relates to a cabinet designed so that a person using the telephone will not be annoyed by surrounding noises or his conversation heard by persons near.

COMBINED TABLE AND DESK.—J. McG. Wood, Court-House, Ohio. Mr. Wood's invention relates to improvements in combined tables and desks, an object being to provide a combined table and desk so arranged that when not in use the desk may be slid into the table, so that the complete device will occupy comparatively little space.

CAN.—C. B. Howell and A. C. De Yoe, Campbell Hall, N. Y. In this case the invention relates to cans used for the transportation and storage of milk and like fluids; and the object of the invention is to provide certain new and useful improvements in cans whereby the ears for the handles of the can are securely fastened in place to prevent the ears from becoming loose or detached and the handle lost.

HOSE-SUPPORTER.—A. M. Wilson, Cherokee, Iowa. Briefly stated, the object of this improvement is to provide a supporter arranged to give the desired comfort and ease to the wearer, especially when moving the limbs or bending the body, and to prevent undue strain on the hose or the parts of the supporter. The supporter may be attached to a corset without danger of accidental detachment when the corset and supporter are worn or when the corset is removed and with it the supporter.

SELF-CLEARING PROPELLER. — C. H. Lee, Southampton, N. Y. This improvement is more especially adapted for use on that class of vessels known as "launches," although the principle may be utilized in propellers adapted for service on other styles of marine vessels. The object is to provide means in co-operative relation to the propeller for removing seaweed and other vegetable matter from the blades, thus making the propeller self-clearing and overcoming the lodgment of matter that interferes with the efficiency of the propeller.

HAIR-PIN.—Louisa Ousey, Bellevue Villa, South Wimbledon, Surrey, England. In this patent the invention is in the nature of an improved hair-pin constructed in such a manner as to enter the hair easily, to glide smoothly over the scalp without pricking, abrading, or scratching the same, and at the same time to hold the pin in the hair against falling out.

BLOCK AND TACKLE.—J. O. Walton, Boston, Mass. The invention in this instance is in the nature of a novel block and tackle designed to provide a very compact construction of great power in which the blocks may be conveniently formed by casting and in which the various runs of the rope are sufficiently separated to avoid rubbing against each other, thereby reducing friction and increasing the efficiency of the device.

BOTTLE-CLOSURE.—B. Clemens, Moundsville, W. Va. The present invention refers to a cap or closure intended particularly for bar-bottles used in retailing liquid goods. It may be applied, however, to various other purposes. It comprises, broadly speaking, a body preferably of spring metal, so as to snap over and retain its position on the mouth of the bottle, a spout projecting from the body, and a peculiarly-arranged cover for the spout.

WRITING-TABLET.—D. F. Curtin, Butte, Mont. In this instance the invention relates to that class of tablets in which a continuous strip or supply of paper is held within a case and drawn out of the case and over the outside thereof which forms a base upon which the paper rests while being written on; and the object is to provide a tablet combined with a supplementary receptacle for holding pencils, matches, stamps, etc.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 5419.—For an attachment for emery wheels or grind stones, to hold a twist drill firmly and at a correct angle to sharpen same.

"U. S." Metal Polish. Indianapolis. Samples free.

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Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 5421.—For machines to graduate linear measure in inches and their subdivisions.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 5422.—For the manufacturers of the Patent Safety Wrench, which is made in Vermant.

American inventions negotiated in Europe. Wenzel & Hamburger, Equitable Building, Berlin, Germany.

Inquiry No. 5423.—For dealers in electro-platers' supplies.

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Inquiry No. 5427.—For manufacturers of pocket match boxes and similar novelties.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 5428.—For manufacturers of brass trimmings for fire apparatus, such as seat rails, hand rails, lantern hangers, etc., for hose wagons and trucks.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 5429.—For manufacturers of transparent celluloid, in very thin sheets.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 5430.—For manufacturers of roller skates.

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Inquiry No. 5431.—For an outfit for cutting stencils in brass sheet.

"The Household Sewing Machine Co., Providence, R. I., is prepared to take on contracts for the manufacture of high grade mechanical apparatus, requiring accurate workmanship, in either machine shop, cabinet work, or foundry lines. Expert mechanics, designers and tool makers. Facilities unexcelled. Estimates furnished on application.'

Inquiry No. 5432.—For parties to stamp steel plates 1-16 inch thick in any desired shape or size.

Patent and Export Company, Christiania, Norway. Specialty: Sale of patents and patented articles in Norway, Sweden and Denmark. Corresp. solicited.

Inquiry No. 5433.—For manufacturers of small circular cardboard boxes about ½ by 2 inches

Inquiry No. 5434.—For makers of small locomotives.

Inquiry No. 5435.—For manufacturers of rubber toys.

Inquiry No. 5436.—For a small family ice machine which makes 100 pounds of ice.

Inquiry No. 5437.—For handpower scroll punches and hand power corking machines, such as used in manufacturing iron fence.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(9369) C. W. B. says: I do not wish to prolong any argument about how the ocean got its saltness, but in your letter in reply to my letter in which I suggested that the ocean became salty in primeval time when the water first settled on the surface of the globe, it brought down chlorine gas and was the medium for uniting that with sodium in such quantity that the whole ocean became salty, as at present. You say that you will not altogether disagree with my suggestion, but then you add: "The water of the ocean was once fresh water. It has received salt from the water that has come into the ocean. LeConte says that salt lakes received their salt from deposits left by the ocean. The ocean received its salt from the rocks." Now, if this last statement is true, how did the salt get into the rocks? Salt is not an original element. There must have been a time when its constituents were separate and independent. All of the seven geological text books that I have before me claim or assume that all salt deposits or brines are remnants of the ocean evaporated. The salt in the rocks that you refer to must have been deposited there by water, and that water was salt water. When I first wrote you my impressions as to the origin of the saltness of the ocean I could not find any authority for it. But now I find it in Prof. Alexander Winchell's "Sketches of Creation." After saying that the deposits of salt found everywhere are dried-up remnants of the ocean, he says, on page 296: "How the waters of the sea came into possession of their saltness is a question of primeval chemistry to which allusion has heretofore been made. It was the result of the chemical actions which took place between the fire-born rocks and the atmospheric acids washed down by the primeval rains, and gathered with the gathering together of the waters." In discussing the various chemical unions that probably took place when the primeval waters settled on the globe he says, on page 60; "Carbonate of lime refusing, for the greater part, to dissolve in sea water, would settle to the bottom and become limestone; while chloride of sodium—which is only the chemist's name for common salt—remained in solution, and thus gave its characteristic salinity to the sea." Unless you can find a better authority than this I think you will have to concede that the ocean got its saltness originally from the union of chlorine gas brought down by the primeval rains which constituted the medium for bringing that and sodium together to form salt; and that all the salt in the rocks, soil, mines, or wells was deposited from some evaporated part of the salty ocean. A. We now understand that we are thinking of the earth at one time and you at another in reference to the genesis of salt water in the ocean. At some time the earth was hot, too hot for water or salt either, to exist. When the cooling had proceeded far enough, the various substances began to combine, and chemical action became possible between the several elements as their various temperatures of association were reached. Thus water was formed. We did not suppose that any one would maintain that water was salt at first, and although you assert the original saltness of the ocean, we must think that you cannot intend this declaration to apply to the genesis of the water in the seas. The salt itself must have been formed at some time when the earth had cooled below the temperature of dissociation of sodium and chlorine. We confess we do not know when this was in the sequence of events under discussion, but suppose any one asserting positively regarding this matter must have definite knowledge on this important point. The quotation you make from Winchell is quite to the point that the water now in the sea was originally fresh. The salt "was the result of the chemical actions which took place between the fire-born rocks and the atmospheric acids washed down by the primeval rains, and gathered in by the gathering together of the waters." That is sufficient. The salt was formed after the water was formed and gathered in by the inflowing of the waters into the lower parts of the earth. It does not seem necessary to pursue the subject farther.

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(9370) G. S. T. asks: 1. By what rule would you determine the size boiler to build to supply a cylinder of a given size? A. The cylinder size is usually made to represent a certain horse-power at some assumed pressure, cut-off, and speed of the piston, and for each horse-power an allowance of 12 square feet of heating surface and a half square foot of grate surface must be provided for in the boiler. 2. What chemical composition is it that when it comes in contact with water immediately burns and bubbles up like lava on the surface? A. Any dry mixture of an acid and an alkali, as for example tartaric acid and carbonate of soda, will make a rapid effervescence when water is dropped on the dry mixture. 3. What is the meaning of the word "phase"? I have several electrical volumes and sets, but one or two of them explain it in such a manner as to make it incomprehensible to a person not very far up in electrical knowledge. Really what I want to know is the difference between a two and a three-phase machine, and how you tell the difference? A. Phase is a current impulse which may be multiphase by alternating two, three, or more times in a multipolar generator of four, six or more poles for each revolution of the armature. The difference may be known by the different direction of the pole winding. See two and three phase system illustrated in SCIENTIFIC AMERICAN SUPPLEMENT Nos. 822, 831, 10 cents each mailed.

(9371) F. A. M. says: We are setting a new steam boiler 60 x 16 inches, and in bringing up the question of water supply, our local steam engineers all contend that with a given amount of fuel more steam can be generated by supplying the boiler with water from a nearby spring by means of an injector, or inspirator which will heat the water before entering the boiler, than can be had if we use the local gravity water system, which has sufficient pressure to force the water into the boiler directly against the steam pressure, but which would be cold as it entered. The writer contends in favor of the gravity system, inasmuch as the effort of lifting the spring water will be overcome. Will you please advise us as to the correctness or advisability of both methods? A. We advise the use of the gravity system to feed your boiler, if it can be trusted for full pressure at all times, but do not neglect other means of feeding your boiler to guard against accidents. The same heat power must be used from the boiler whether the water is fed cold or is heated by the injector. If the gravity supply can be supplemented by waste heat of the exhaust steam or chimney heat, the greatest economy may be obtained. If cold-water feed is adopted, the water should enter the boiler above the tubes and be distributed through a perforated pipe for best effect.

(9372) J. P. M. asks: With a heating apparatus for a residence, that seems to burn either anthracite or bituminous coal with equal facility, what will be the comparative heating value of the two of average market quality, weight for weight? A. The total heat units of combustion of the good marketable coals of the United States scarcely varies 1,000 heat units from the mean of 14,000 heat units per pound of the various kinds, as semi-bituminous, bituminous, and the various grades of anthracite. The available heat per pound of fuel depends much upon the method of firing and the kind of furnace used. In furnaces for heating dwellings, far the larger number are designed for anthracite coal and are not suitable or economical with bituminous coal. The excessive waste of smoke fouls the heating surfaces and the heat is lost through the chimney. In furnaces with underfeed appliances the economy in heating gives bituminous coal an equal quality with anthracite; but the care is somewhat greater.

(9373) E. H. A. writes: I was much interested in what you had to say about the reason for water hammer (Query 9329, page 239 of SCIENTIFIC AMERICAN for March 19, 1904). We are troubled with musical water pipes, always in the cold-water pipes. Will you kindly give the cause of it? Can it be stopped permanently? Turning on the cold water and then shutting it off stops it for the time being. Sometimes it stops for a long time. A. We have little experience with musical water pipes, except from the tremor of loose valves when drawing water, which may be heard all over the house when any bibb is running with a loose valve disk. The noise from the kitchen boiler by the condensation of the steam from the water back is quickly stopped by opening the hot-water bibb and drawing off a quantity of hot water. This noise is also heard all over the house by the reverberation of the pipe system. Sometimes leakage through the rubber disks of compression valves makes a musical sound by the vibration of the rubber lip of the valve disk. Its location is easily traced, when a new disk may be inserted. Your plumber should know all about this trouble and its correction.

(9374) S. G. A. asks: Would thank you to inform me in the next issue of your paper, whether the buoyant effect of water at the surface is greater in deep water than in shallow; that is, will deep water carry a greater weight in a boat than shallow water will? A. The buoyant effect of water on a boat is the weight of water the boat displaces. It is therefore not greater at one part of the sea than at another part. The depth of the water has no effect on buoyancy.

(9375) J. A. M. says: In rounding a curve on a railroad one rail is longer than the other; the wheels on a car that are on the longest rail must travel farther than the wheels on the short rail. As axle and wheel are one piece, both wheels must make the same number of revolutions. Please explain how this is done. A. It is very evident that with fixed car wheels on the axle, a considerable slipping must be done in rounding a curve. The taper tread on the wheels was designed to help the curve traverse by riding the high side of the tread on the outer rail and the low or smaller part of the tread on the inner rail from the centrifugal force of rounding the curve. This but slightly fills the requirement, and slipping of the wheels does the rest. By the centrifugal force of rounding a curve, the greatest pressure or load is thrown on the outer wheels and the inner ones do most of the slipping forward. By close observation of the rails on curves, it may be plainly seen that the wheels slip on both the rails, as shown by the wear.

(9376) M. G. D. writes: In a discussion I contended that steam from a boiler at say 100 pounds pressure, allowed to expand to atmospheric pressure in a system of heated tubes, will issue from this heating coil at or above the temperature of the steam in the boiler if the tubes are kept hot enough; in other words, that high-temperature steam can be obtained without high pressure by an arrangement as above described. The other party says that under no condition can steam be obtained above 212 deg. F. without increasing the pressure above that of the atmosphere. A. Steam circulating in heating coils cannot be kept as hot as the steam in the boiler without outside heat to counteract radiation; but by expansion to atmospheric pressure in a coil without receiving heat, pressure and temperature will both fall and temperature of the exhaust will be 212 deg. F. By superheating or adding heat in the coil, any desired temperature, even far above that of the boiler, may be had in the exhaust and far above the temperature due to the pressure in the pipe of the coil. The general principles of the use of superheated steam are discussed and illustrated in SCIENTIFIC AMERICAN SUPPLEMENT Nos. 1068 and 1069. We think that the articles on superheated steam in SCIENTIFIC AMERICAN No. 24, vol. 74, also SUPPLEMENT Nos. 1387 and 1408, would also be of interest to you; price 10 cents each mailed.

(9377) S. T. Co. writes: We note in a recent issue that you advise the use of alcohol to remove ink spots from typewriter keys. Allow us to state from experience that this is not effective, because as celluloid keys are referred to, the alcohol (particularly if wood alcohol) will dissolve the celluloid and ruin the appearance of the keys. Javelle water is the best substance to use.

NEW BOOKS, ETC.

THE FACTORY MANAGER AND ACCOUNTANT. Some Examples of the Latest American Factory Practice. Collected and Arranged by Horace Lucian Arnold. New York: The Engineering Magazine. 1903. 8vo. Pp. 431. Price $5.

The author deals with this subject in an admirable manner, and the forms or blanks which are illustrated would certainly tend to give the manager of any large plant most valuable points. The book is made up of several complete factory systems, both the costing and commercial blanks being accurately reproduced, each one having the actual size in inches given, together with its color and the material on which it is printed. The reader is thus enabled to reproduce any form and apply it in his own practice, and he may also trace its action and effects in relation to the entire accounting of the factory, and can compare his own practice with that of other managers, cost-keepers, or accountants. It is certainly to the credit of the various companies represented that they have allowed their forms to be reproduced. It is an excellent book.

SCHUTZ DER EISENBAHNEN GEGEN SCHNEEVERWEHUNGEN UND LAWINEN. Von E. Schubert. With 103 illustrations and an atlas of 38 plates. Leipzig: Wilhelm Engelmann. 1903. 8vo. Pp. 62. Price $1.25.

This monograph forms part of Schubert and Fink's "Handbook of Engineering Sciences," in which it appeared as the twelfth chapter under the title "Means for Securing the Safety of Railway Traffic." Beginning with the discussion of snowstorms, the author treats of snowdrifts and their effect upon railways. As a protection against snowdrifts he recommends various constructions, which consist either in modifications of the roadbed itself, or in cutting off the wind. A similar treatment is accorded to the subject of snow avalanches. One of the most striking parts of the book is an excellent series of illustrations, which clearly show how snowdrifts and avalanches originate, and how their course may be checked by walls, dams, fences, and the like.

FIRE AND EXPLOSION RISKS. By Dr. Von Schwartz. Translated from the German edition by Charles T. C. Salter. Philadelphia: J. B. Lippincott Company. 1904. 8vo. Pp. 357. Price, $5.

This work forms a complete handbook for fire insurance officials, members of the fire department, lawyers, factory inspectors and owners; in fact, anyone interested in fire risks and dangers and their prevention.

The book is divided into eleven parts, which treat of such subjects as the following: Fires and explosions of a general character; fireproofing; dangers caused by sources of light and heat, gases, agricultural products, various industrial materials, lighting and lighting materials; dangers in various establishments, such as drug stores, breweries, soap and sugar works, and the like; and danger from petroleum, oils, ethers, and other liquids, as well as from metals, oxides, acids, and salts. In completion of the general thoroughness with which the subject is treated, the book contains an appendix of eight tables giving the boiling, flashing, and fusing points of various liquids and substances, the working temperatures permissible in the various trades, together with an explanation of some of the principal processes and their risks, and dangerous substances that are liable to ignite and explode spontaneously, with their reactions. As a reference work for those having to do with fires and fire risks, the value of this volume is unquestionable.

ELEMENTS OF THEORETICAL MECHANICS. By Alexander Ziwet. New York: The Macmillan Company. 1904. 8vo. Pp. 494. Price, $5.

This work is a revised edition of "An Elementary Treatise on Theoretical Mechanics," which was published by Prof. Ziwet ten years ago. It contains practically the whole course in theoretical mechanics as taught at the University of Michigan; but, on account of the time limit of the course and the mathematical capabilities of the usual second-year student, the subject matter is confined largely to problems in one and two dimensions. Thus, although such problems as the motion of a rigid body around a fixed point had to be omitted, rectilinear motion and rotation about fixed axis have been more thoroughly treated than heretofore, and some illustrations of plane motion have been given. Fundamental subjects, such as simple and compound harmonic motion, motion under central forces, and the theory of moments of inertia, are treated very thoroughly. The book is theoretical in character, though numerous practical illustrations of the theories discussed are given. It is intended for use chiefly as a textbook, and the author's expressed desire is that it may tend to stimulate the study of theoretical mechanics in engineering schools.

ANTHRACITE COAL COMMUNITIES. By Peter Roberts, PhD. New York: The Macmillan Company. 1904. 8vo. Pp. 387. Price, $3.50.

This new work on the anthracite coal fields by Mr. Roberts will be welcomed by all who are familiar with his previous volume on "The Anthracite Coal Industry," published in 1901. While the facts relative to the economic life of the people of these regions were given in the former work, little or nothing was said concerning the social and moral life. In the present volume this is thoroughly dealt with; and the author, besides having a personal acquaintance with the people he describes, has had the benefit of much valuable testimony given before the Coal Strike Commission a year ago. The home life, different ways of living, the intellectual and religious life, the schools, the saloons, and the political system of these hard-working people are graphically and interestingly portrayed, while some 25 illustrations from photographs give one a good idea of the appearance of the people and of their homes.

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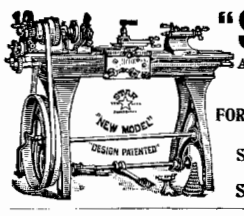

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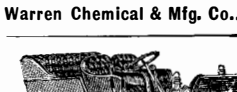

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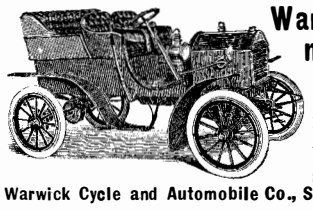

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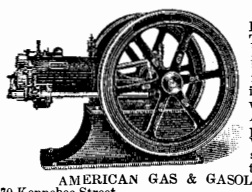

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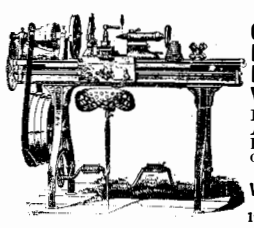

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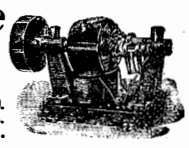

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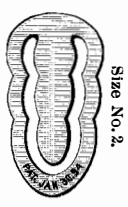

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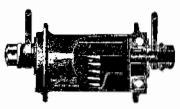

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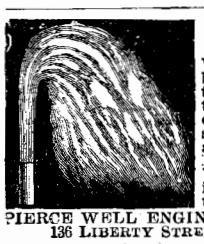

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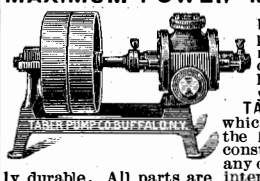

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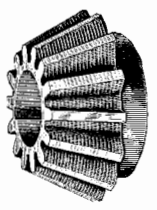

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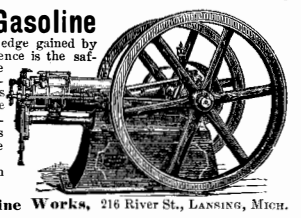

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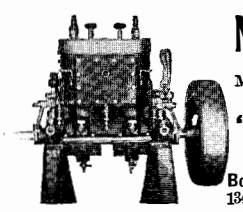

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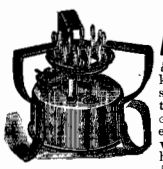

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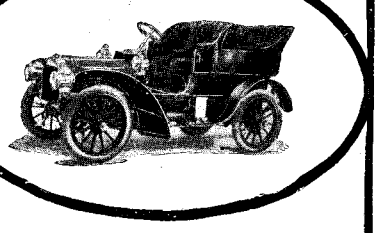

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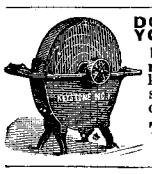

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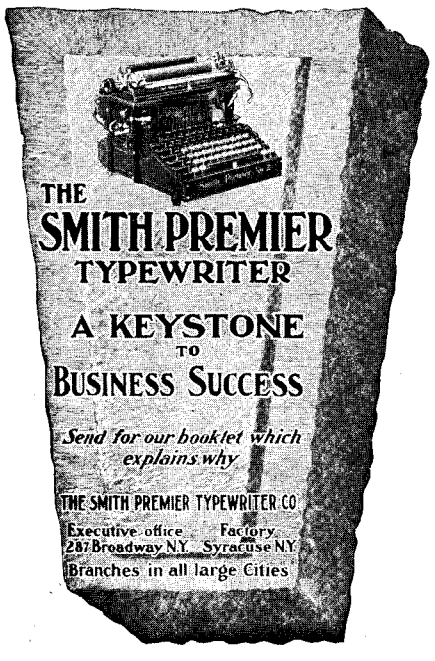

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Railway collisions, device for preventing, Holtmann & Butler	757,191
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Railway, electric, W. B. Potter	753,980
Railway, electric, D. J. Cable	757,264
Railway electric safety system, Hanna & Gilman	756,957
Railway gate, L. Trebert	757,367
Railway joint and chair, Hooper & Sunday	756,962
Railway signal, W. C. Miner	757,332
Railway signal, electric, W. B. Ramsay	757,346
Railway switch, electric, M. A. Marks, Jr.	756,870
Railway system safety device, electric, G. Gibbs	757,107
Railway third rail, electric, P. T. McGowan	757,138
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Railway tie, metallic, J. M. Hansen	757,111
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Refrigeration system and apparatus, C. J. Coleman	757,392
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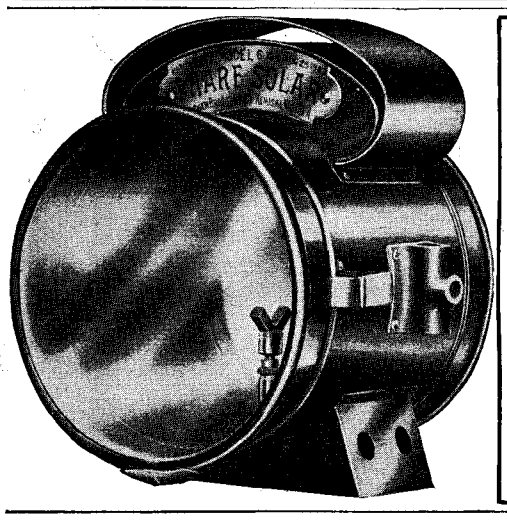

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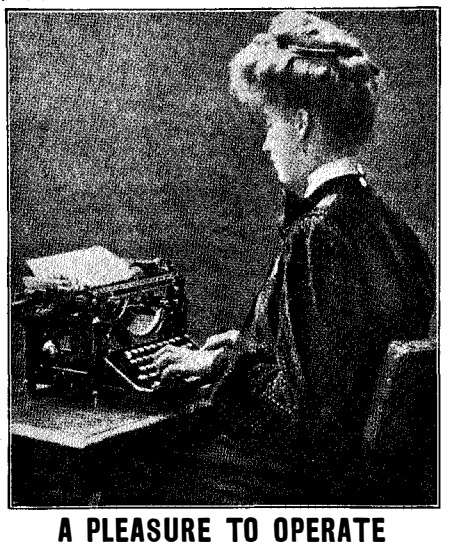

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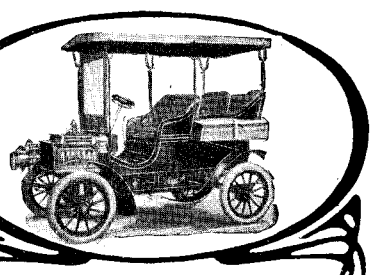

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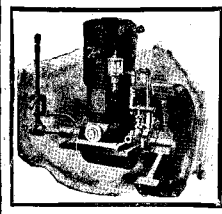

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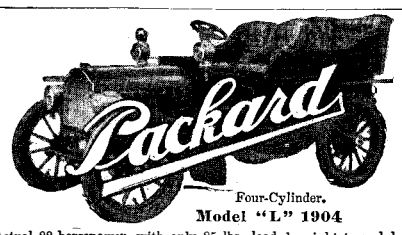

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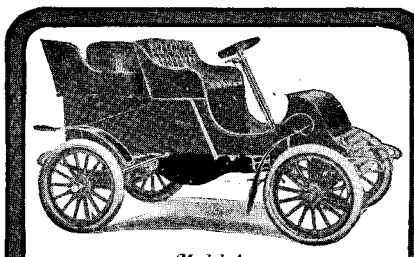

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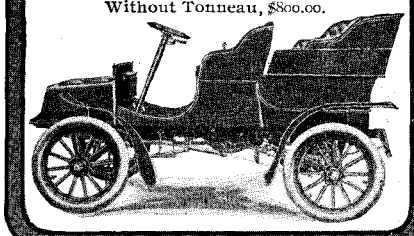

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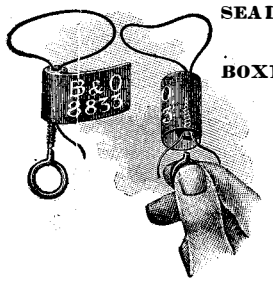

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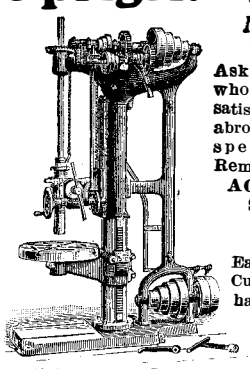

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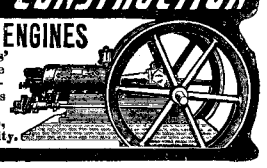

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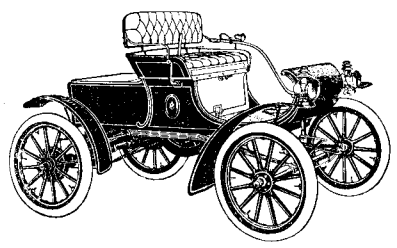

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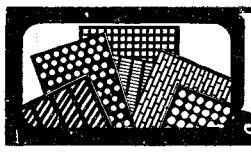

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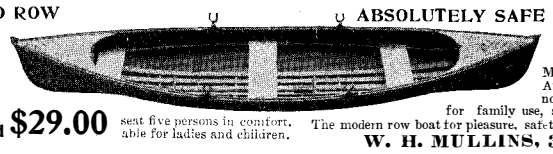

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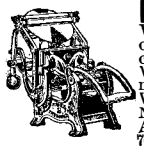

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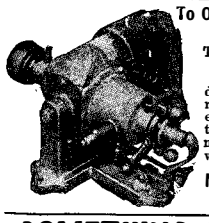

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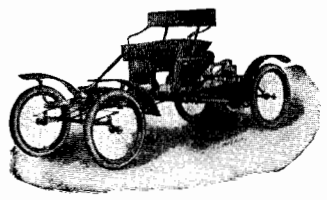

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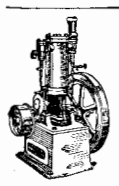

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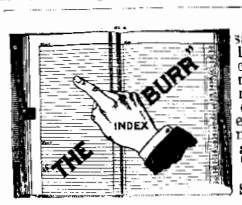

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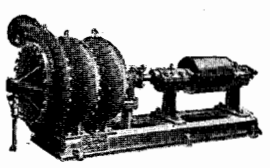

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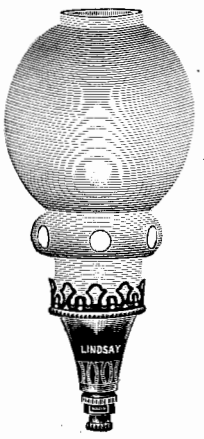

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We have completed arrangements for several thousand dollars' worth of space in the leading popular magazines—advertising to start at once and run until 1905. The general public (about 20 million or more) will learn of the merits of the

No. 5 Lindsay High Candle Power Lamp

Reliable men wanted in every locality to take care of the resulting business.
☞ Become recognized *now* as beadquarters for this light in your locality.
Big money and Little work } For hustlers.
Write at once for particulars.
Lindsay & Co, Dept. S, Chicago

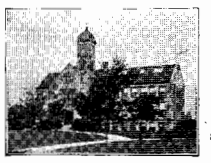
CASOT'S
Sulpho-Napthol
TRADE MARK
LIQUID CLEANLINESS

A SICK-ROOM NECESSITY

The reliable ANTISEPTIC, DISINFECTANT and DEODORANT used for many years by physicians and nurses at hospitals and homes for arresting and preventing disease, purifying air, washing vessels, utensils, etc. At all dealers or 10 and 25 cents by mail. Look for above trade-mark. Genuine only bears it. Avoid imitations. Valuable medical literature FREE.
Sulpho-Napthol Co., 15 Haymarket Sq., Boston, Mass.

HOROLOGICAL DEPARTMENT

BRADLEY POLYTECHNIC INSTITUTE



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LARGEST and BEST WATCH SCHOOL in AMERICA
We teach Watch Work, Jewelry, Engraving, Clock Work, Optics. Tuition reasonable. Board and rooms near school at moderate rates.
Send for Catalog of Information.

Earn a Bicycle

taking orders from sample wheel furnished by us. We want an **Active Agent** in each town. **Large profits.** *Write for special offer.*
Highest Grade **1904 Models** **$8.75 to $17**
Coaster Brakes, Hedgethorne Puncture-proof Tires and best equipment.
1902 & 1903 Models, Best Makes **$7 to $12**
500 Second-Hand Wheels All Makes & Models, good as new **$3 to $8**
Great **Factory Clearing Sale** at *half factory cost.*
We **Ship on Approval** *without a cent deposit,* and allow **TEN DAYS FREE TRIAL** on every bicycle. Any wheel not satisfactory *returned at our expense. Write at once* for catalogs and our **special offer, AUTOMOBILES, TIRES,** Sewing Machines, Sundries, etc., *half usual prices.*
MEAD CYCLE CO., Dept. 59C Chicago

BABBITT METALS.—SIX IMPORTANT formulas. SCIENTIFIC AMERICAN SUPPLEMENT 1123. Price 10 cents. For sale by Munn & Co. and all newsdealers. Send for catalogue.

Anybody can make Good Pictures by the

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System. Better results than the old way, too.

EASTMAN KODAK CO.

Catalogue free at the dealers or by mail.

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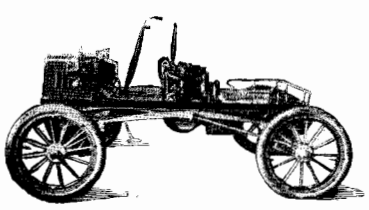

BUCKMOBILE

The average American road is little adapted for the use of automobiles, but by reason of its peculiar buckboard construction all roads are alike to the "Buckmobile." It has every feature which should be incorporated in 1904 construction. Write for name of nearest agent or we will be pleased to sell you direct. Send to-day for catalogue.

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New York Agents, 1900 Broadway, cor. 63d St.

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The HARTFORD SINGLE TUBE and DUNLOP DOUBLE TUBE Tires

Stand foremost for Uniform Quality, Honest Construction and Durability. That each is the most serviceable tire of its class is universally acknowledged by those buyers who desire The Best regardless of cost, and thus consider the question of their needs intelligently. Let us advise you regarding the proper size and weight of tire best adapted to your requirements Branches in principal cities.

The HARTFORD RUBBER WORKS COMPANY
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(Users of SOLID RUBBER TIRES may rest assured that our reputation as makers of only high-class goods will be carefully sustained in connection with this product)

The culmination of progressive enterprise

Western Department, Chicago, Ill. **Two-Speed Gear, Coaster Brake** Eastern Department, Hartford, Conn.

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Catalogues free at our 10,000 dealers' stores or any one catalogue mailed on receipt of 2-cent stamp.

POPE MANUFACTURING COMPANY

Auto Tires

Special Prices on all the Best Tires

You'll save money by getting your new tires from us. Write us what you want and we'll quote you prices that will prove it.
POST & LESTER CO.
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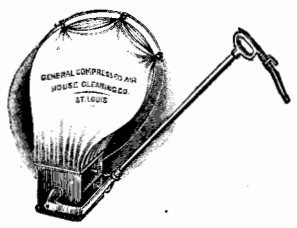
Compressed Air House Cleaning

DUSTLESS METHOD

Carpets, Furniture, Draperies, Tapestries, Decorations, Ceilings and Walls Cleaned, Disinfected and Renovated. Carpets not taken up. The dust which is in and under them is collected and removed by Compressed Air. A revolution in house cleaning—quick, sanitary, effective. No more dismantled rooms, no more dust, no more worry. Subsidiary companies are now being formed in various cities. Write for catalog



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General Office and Factory
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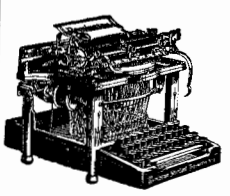
are used for instruction purposes in the schools of the United States and Canada—3,499 MORE THAN ALL OTHER MAKES OF WRITING MACHINES COMBINED.



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MFRS OF CRUCIBLE SHEET STEEL
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